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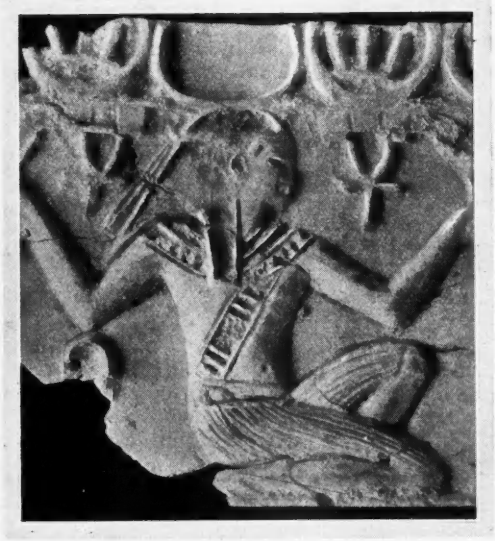

AN IVORY PLAQUE FROM SAMARIA.

(See page 377.)

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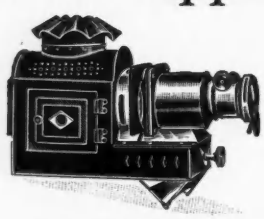

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DISCOVERY

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Notes of the Month.

A DISCOVERY of unusual interest is reported from Russia. In the Crimea, near the Chersonese lighthouse, a fortified city completely submerged by the sea has been examined by submarine methods. The information which had filtered through before the official report was received from the State Academy of Arts at Moscow roused a certain amount of scepticism. But it is now clear that the submerged city is more than a fable. It is identified with the fortified city of Old Chersonesus, mentioned by Strabo, and examination shows that it had been abandoned in the second century B.C. The walls were apparently about four metres thick, and there were eighteen round defensive towers at intervals. Dwelling houses and what seems to have been an acropolis have also been identified. Rapid submergence in the centuries after the abandonment of the city has caused this interesting site to be forgotten.

* * * * *

An expedition recently left London for the Gulf of Guinea with the object of studying the flora and fauna of the Spanish islands in the gulf. The party is organized by the British Museum (Natural History), and funds have been provided by grants from the Percy Sladen Trustees and the Godman Exploration Fund. According to *The Times*, telegrams lately received from the island of São Thomé announced the arrival of the two naturalists sent, Mr. W. H. T. Tams, of the Department of Entomology, and Mr. A. W. Exell, of the Department of Botany. Both will be absent from England about six months, and the survey will cover the islands of São Thomé, Principé, Fernando Po, and Annobon. Mr. Tams, whose principal interest will be the moths of these islands, will also collect reptiles, birds, and other larger creatures, while Mr. Exell is to observe the distribution of African plants and collect specimens. From what is already known it appears that the flora of the islands possess a certain similarity to the flora of the Cameroon Peak and a less close resemblance to the mountain flora of East Africa.

* * * * *

The first new mineral to be discovered by X-rays has been identified, and on another page the discovery is described in detail by Mr. F. A. Bannister, who has been engaged in the work. The new mineral has been named "braggite" in honour of Sir William Bragg, and was identified among a series of minute crystals which lately arrived from the Transvaal. Its principal constituents are platinum and palladium. The name chosen for the mineral is highly appropriate, for both Sir William Bragg and his son, Professor W. L. Bragg, are distinguished for their pioneer work in connexion with X-ray methods of analysis.

* * * * *

A letter in our correspondence columns calls attention to the national conference on "The Place of Biology in Education," now being held in London. The faults and omissions of education are a perpetual topic for criticism, much of which is ill-informed and unfair. But the comparative neglect of biology in general education has become apparent in various phases of national life, and attention has been drawn to it by a number of authoritative bodies and by government committees. What is clearly needed is the inclusion of some general knowledge of the "life sciences" rather than increased opportunities for the training of specialists. Various lines of approach to this end have been proposed—through nature study by Sir Arthur Thomson; through general science by Professor Julian Huxley; through physiology by Professor Winifred Cullis. A useful background, and

*

an aptitude for observing living things, can be acquired by any of these means, and no doubt other proposals will be made at the Conference, for the speakers include Sir Michael Sadler, Sir William Hardy, Professor A. V. Hill and Professor A. C. Seward.

* * * * *

The further grant of £5,000 from the Rockefeller Trustees to the research funds of the National Institute of Industrial Psychology has enabled this body to embark on an extensive series of new investigations. This is the fourth grant to be made by the Rockefeller Foundation, and is to be expended during the years 1933-6. The new research will be conducted under the personal direction of Dr. C. S. Myers, F.R.S., the principal of the Institute, and will have a direct bearing on industrial and occupational life. The valuable work carried on by this enterprising body has been described in several articles in *Discovery*. In these days of economy, grants for scientific research are sometimes the subject of public criticism; there is no question that under Dr. Myers' discriminating guidance this grant will be wisely spent. A series of investigations in progress will improve the existing methods of giving vocational guidance to young people.

* * * * *

This has been a notable year in the short but already impressive history of television. Some outstanding developments are briefly reviewed on another page. The beginning of regular transmissions by the B.B.C. was, of course, the event of the year, and since the first programme in August, which opened modestly with singing and dancing, the transmissions have steadily improved. The producer is a resourceful person, and the programmes have even included a performing sea-lion. The televising of the Derby has already been described in *Discovery*. This must be numbered among the accomplishments of the year, for it was the first occasion on which a daylight transmission had been successfully projected on a cinema screen to be watched by two thousand people. In America, the broadcast of sight and sound on one wave was an important step forward: an orchestra playing on the roof of a New York hotel was directed by a conductor in the studio a quarter of a mile away. Television is now attracting the attention of inventors in many countries; and in England Mr. J. L. Baird has lately perfected a new receiver in which the screen can be seen by a roomful of people at the same time.

* * * * *

The latest research on ultra-violet light suggests that these rays may play an important and unsuspected part in growth. Onions have been used in this work because the roots are particularly regular and are easily observed in growth. In a lecture to the Royal Institution, Professor E. N. da C. Andrade stated that there is experimental evidence to show that the tips of onion roots give out an ultra-violet radiation. Some investigators claim that these rays stimulate the division of the cells, and consequently growth, in other onion roots. Similar rays, detected by their action on onion roots, are given out by certain other tissues, and in particular by cancerous growths, but not by so-called "benignant" growths. The same effect has been produced by rays from an ultra-violet lamp. The subject is complicated by the antagonistic action of certain other classes of ultra-violet, and much more research is required.

* * * * *

At the thirtieth annual meeting of the South African Association for the Advancement of Science, held at Durban, it was decided to press for the establishment of a national research organization on similar lines to the committees of scientific and industrial research in other countries. Dr. P. J. du Toit, Director of Veterinary Services for the Union of South Africa, was the President this year, and the subject of his address was "Africa's Debt to Science." The South Africa medal and grant was awarded to Professor J. W. Bews, in recognition of his ecological research and of his work on grasses. The fund from which this award is made was raised to commemorate the first visit of the British Association to South Africa in 1905. At each meeting a popular address is arranged. On this occasion General J. C. Smuts spoke on "Climate and Man in Africa." The meeting next year will take place at Barberton, under the presidency of Dr. H. Spencer Jones, His Majesty's Astronomer at Cape Town.

* * * * *

Among the most interesting acquisitions by the British Museum this month is a cylindrical stone tablet of Shamshi-Adad I, King of Assyria, dated about 1850 B.C. The tablet describes the building of the temple at Nineveh and was discovered in the course of Dr. Campbell Thompson's excavations. Other acquisitions from the same source include tablets from the royal library, and a stratified collection of pottery; among the latter are the earliest specimens yet found in Iraq of the very early polished and painted ware hitherto only known from Syria. The British Museum has also acquired a collection of remarkable antiques from Middle Egypt, including small sculptures of the Fifth Dynasty. These are among the results of Mr. Guy Brunton's expedition.

New Excavations at Samaria.

By Kathleen Kenyon.

Member of the Anglo-American Expedition.

By the excavation of the sites of Israelite towns much has been done in recent years to supplement the historical narrative in the Bible. As regards the Old Testament, second in importance only to Jerusalem comes Samaria, the capital of the Northern Kingdom. The following is an account of the latest work on this site.

As an archaeological site Samaria has one great advantage over Jerusalem, that while the latter is covered by a flourishing modern town, the former has only a small Arab village on its fringes, and therefore all the most important portions of the ancient town can be freely examined.

Excavations were undertaken there from 1908-11 by Harvard University, and in 1931 and 1932 these were continued by a joint expedition representing Harvard University, The British School of Archaeology in Jerusalem, the Palestine Exploration Fund, the British Academy, and the Hebrew University of Jerusalem, under the direction of Mr. J. W. Crowfoot, director of the British School of Archaeology in Jerusalem. These will be continued in the spring of 1933.

The site of Samaria has never been lost. It lies fifty miles north of Jerusalem, on the western edge of the backbone of hills separating the Mediterranean from the Jordan Valley. The summit is 1,450 feet above sea level, and the hill stands out boldly in the middle of a basin surrounded by rather higher hills, open only towards the west, where there is a magnificent view across the coastal plain to the Mediterranean, some twenty miles away.

The site is obviously one of considerable strategic importance, to which the only drawback is the lack of a water supply. This deficiency was remedied by a great number of cisterns to hold rain water, which riddle the hill in all directions. The first town to be built on the site, however, was not till *c.* 880 B.C., when Omri, the father of Ahab, moved the capital of the Kingdom thither from Tirzah, which lies much lower towards the Jordan Valley. Last year evidence was found of some slight occupation in the Middle Bronze Age (*c.* 2000 B.C.), but Omri was undoubtedly the first founder of Samaria.

Omri is barely mentioned in the Bible, and the only fact recorded of him is that he reigned ten years after establishing himself at Samaria. The results of the excavations, however, show that he must have been a great builder, which doubtless implies that he was a strong ruler and good organizer as well. His buildings were set on the soft limestone of the hill itself, on which at that time there can have been practically no soil. Even where the walls themselves have vanished, we can trace much of the plan of his buildings from the rock-cut trenches in which they were laid. The palace enclosure occupied the top-most ridge of the hill, which was a narrow strip running east and west, and much of the excavation has been devoted to examining this area.

The expedition of 1908-11 uncovered the westernmost extremity of the area, and discovered a range of buildings on an impressive scale. This was thought to be the palace of the kings, but the fact discovered by the present expedition that the enclosure walls stretch for a distance of at least 250 yards further to the east suggests that the actual palace may remain to be found. The walls of the buildings, however, show the very high standard of construction of the period. They are built of large blocks of limestone quarried from the hill itself, forming walls about a yard thick, with the face of the stones beautifully dressed. During the seasons of 1931-32 the south enclosure wall has been traced for a distance of 250 yards, while the north wall has been traced for part of this distance, and the buildings adjoining it have been cleared.

THE HILL OF SAMARIA FROM THE EAST.

This photograph shows the panoramic view, looking toward the Mediterranean. The modern Arab village can be seen on the nearer slopes.

The south wall consisted of a tremendously thick wall built against a high rock scarp, while the north one was a double wall connected by a number of cross walls, thus forming a number of casemates. Within these walls was a courtyard with buildings dotted about in it. An extremely fine portion of the outer wall of the city was also uncovered in 1931, with the stones beautifully bossed with a margin on three sides, which is certainly the best bit of Israelite masonry yet found. Most of the Israelite buildings show at least two periods, and these may with probability, though there is no direct evidence, be assigned to Omri and his more famous son Ahab, with some further additions, possibly in the time of Jeroboam II.

A considerable number of objects of the Israelite period have been found. These, of course, include a lot of pottery, and also a number of small stone saucers which were possibly the cosmetic boxes of Jezebel and her ladies, for they contain a number of small holes with traces of different colours in them, and a central depression for mixing the paints. Among the most important finds of the earlier expedition were a number of potsherds which had been used to inscribe the amount of the tribute brought in by the surrounding villages, and these are of very great importance both as regards Hebrew topography and palaeography.

THE FORECOURT OF HEROD'S TEMPLE.

A view of the north-east corner. In the background are two principal retaining walls, forming the northern limit of the artificial platform made for the purpose.

The importance of these ostraca is, however, equalled, though in quite a different way, by some finds of last year's work. These are a considerable number of ivory carvings, probably furniture fittings, which may reasonably be attributed to Ahab's famous ivory palace. The earth in which they were found had been disturbed in Hellenistic times, but we can date them quite confidently from their extraordinarily close resemblance to some found at Arslan-Tash in N. Syria, which are dated by an inscription to the reign of Hazael of Damascus, a contemporary of Ahab. Another group of ivories which bear a most striking resemblance to those of Samaria are those found by Layard at Tell Nimrud in Assyria. This resemblance is so close that one is tempted to see in them some of the loot when Samaria was sacked by the Assyrians.

The style of most of the ivories, which are mostly in the form of plaques in low relief with mythological scenes carved on them, is definitely Egyptian, though some of them certainly show the admixture of other styles, and approach Hittite work. It is quite clear, though, that they are not the work of native Egyptians, as is shown by details such as lotus flowers growing out of trees, and the complete absence (with one exception) of the use of hieroglyphics. Everything points to their being the work of Syrian artists conversant with Egyptian models. Many fragments of burnt ivory were found, and the unburnt ones were apparently saved by the collapse on to them of a mud roof or wall. These ivories are definitely the most striking objects of their kind found in Palestine, and although, of course, the workmanship is poor according to the standard of Egyptian work of the best period, they are extremely interesting as coming from what was after all a very poor little province compared with the great empires of the east.

Samaria was sacked by the Assyrians in 720 B.C. and most of the inhabitants carried away into captivity. From that time the importance of Samaria diminished considerably, but the occupation of the site apparently continued, and in some cases parts of the plans of the Israelite buildings was not completely lost. The plans of a succession of buildings can be traced, but unfortunately it is extremely difficult to date them more than relatively, owing to the small amount of attention that has hitherto been paid to the pottery of this period in Palestine. The work of the excavator, too, is much complicated by the fact that each new lot of builders would rob the walls of their predecessors in order to obtain stones for their own walls, and thus many of the plans are lamentably incomplete; in any case only the foundations of walls remain, with no

superstructure. Indeed, if it was not for the fact that the Israelites laid their walls in rock trenches, we should have a quite negligible amount of information concerning their buildings.

There is enough evidence, however, to suggest the kind of arrangement of the town in the various periods. As with so many hill-top sites, the most striking change in the place as time went on was the gradual extension of the level area on the top of the hill. The Israelites had not bothered to try and level up the hill top, but their buildings had clearly accommodated themselves to the natural contours of the rock, adjoining rooms being often of very varying floor levels. Also they had confined their important buildings to a narrow east and west ridge where the rock was highest. In the course of time, however, an artificial platform was gradually built up by the accumulation of debris, held up a succession of strong retaining walls, which gradually advanced rather further down the hill on all sides, thus enlarging the area of the hill top. These walls took the place of the walls of the Israelite palace enclosure mentioned above, and like them doubtless served as fort walls for the inner town as well as retaining walls. The illustration shows a succession of these retaining walls on the north side of the hill, at a point where they were closer together than usual. Running away from the camera are the rock cut trenches of the double Israelite wall, with the trenches and some of the stones of the cross walls connecting them. On the left is the latest retaining wall, which can be dated to soon after 200 B.C., and it was quite clear from the stratification that there was at least one other wall (now vanished) intermediate in date.

THE ISRAELITE WALLS.

To the right of the camera and near the left hand side are the parallel trenches of the Israelite casemated enclosure wall on the north of the palace area.

AN IVORY PLAQUE.

One of the ivory plaques discovered during the last year's excavations. As can be seen from the photograph, it is strongly Egyptian in style.

Samaria did not again become a city of the first importance until the time of Herod the Great. He rebuilt the whole city, more than doubling its area, and renamed it Sebastia (the Greek equivalent of Augusta), which name it still bears. His temple to Augustus on the top of the hill above the Israelite palace area, his basilica and part of the forum, and his great west gate were excavated by the 1908-11 expedition, and all are most impressive monuments to his grandiose schemes. One of the most interesting pieces of work of the present excavations has been the tracing of the extent of the forecourt of the temple. This faced north, and the narrowness of the ridge, even with the accumulation of centuries, did not allow of a forecourt on the scale of the temple. Herod therefore caused to be constructed a huge platform jutting out from the side of the ridge towards the north for a distance of some thirty yards, held up by a series of massive retaining walls. The illustration shows the foundations of two of these walls running across the picture in the background, while the transverse wall in the foreground probably replaces a lower one. The main side wall of the platform is in the left-centre background, with a man on it, and further forward to the left is a corner tower which finished off the construction. The smaller walls represent rooms of houses which were destroyed when Herod laid out his temple, and which were all covered by a great earth ramp running down from the retaining wall.

The other portion of the Herodian town excavated in 1931-32 has been the so-called Hippodrome. This lies in a long depression half-way down the hill, adjoining the Herodian city wall, and is probably a palaestra or general exercise ground rather than a

hippodrome, since there can never have been seats up the sides of the hill. A number of the columns of the surrounding colonnade are visible above the surface, but excavation proved that these did not belong to the original structure. Portions of the wall surrounding the colonnade were found to rest on a wall at a lower level to which painted wall plaster was still adhering to a height of five feet from the floor; on this were scratched the comments of one gladiator on another, and other rude grafiti. This linked up with a Doric colonnade at the south end of the arena, while the later structure was in the Corinthian style. Extensive remains were found at this end, where the arena was cut back into the hillside, and there is strong reason to believe that at neither period was the structure completed owing to falls of rock. The Doric structure is apparently of the Herodian period, but the later one has not yet been satisfactorily dated.

Very little is known from external sources of the history of Samaria following the Herodian period. Excavation has shown that there was a great rebuilding, including the temple, which the earlier expedition attributed tc Septimius Severus, when the town was given the status of a colony. But the evidence for this date is not satisfactory, and it is possibly earlier. A succession of buildings running on well into Byzantine times has been found, but since they are very little below the present surface, they are much ruined. A certain importance, however, did attach to Samaria right down into the Middle Ages. At an early period, certainly by the fifth century A.D., owing to confusion between Herod the Great, who was known to be associated with Samaria, and his son Herod Antipas, John the Baptist came to be connected with the town, and the belief arose that this was the place of his execution. In the Crusading period a magnificent cathedral was built to him, part of which is now used as a mosque. But it was known from pilgrims' chronicles that there was a Greek church as well.

"Lands of the Monastery."

The site of this was suggested by the name of the field, "Lands of the Monastery," and by the fact (very hampering to excavation) that the small Christian community (descendants of the original Christians of the country) still used it as their burial ground. Excavation revealed a most interesting little church, dating probably from the sixth century and possibly in use up to the sixteenth. The most important find of all was a little crypt which obviously represented the supposed tomb of John—though there is another under the Latin church—with wall paintings of the twelfth century. There are two principal scenes, the uppermost representing the execution of John, while the lower shows the "Invention of the Head of John the Baptist." A big semi-circle with flowers growing on it is clearly the hill of Samaria, while in it is a yawning hole with two men digging at it. Fragments of a nimbus can be seen, but the head, which obviously originally formed the centre, has been mutilated. All this exactly corresponds with descriptions of Phocas and other pilgrims, and is a most interesting and important addition to our knowledge of the country during the medieval period.

This sketch may serve to show the great importance of the excavations at Samaria. There can be few other sites which have such a wide interest and offer such a diversity of material, except the unfortunately large number which have a modern town on top of the old. The difficulties of the work are very considerable, with such a great succession of periods one on top of the other, each destroying much of its predecessors' buildings, and much care is needed to disentangle them. It is to be hoped that the excavations of 1933, and of subsequent years if money can be found, will prove equally fruitful in material, and will add substantially to our knowledge of Samaria in Biblical and Crusading times.

The "Polar Year" Expedition.

THE National Polar Year Committee has received a dispatch from Mr. J. M. Stagg, the leader of the British Polar Year Expedition, at Fort Rae in Canada. The expedition has been organized by the Committee, with Government support, as the British contribution to the second Polar Year, which is supported by the principal countries of the world. In his dispatch (reported in *The Times*) Mr. Stagg says that "the first big jobs were the preparing of huts for instrumental gear. By August 1 every instrument was functioning and the routine of observations every three hours throughout the day was instituted. Already, in July, aurora had been noticed on several evenings, and all during August there was a display every evening. Rae must be near, if not actually inside, the zone of maximum auroral frequency.

"From our early days here the Indians have been amused spectators of our activities. The balloons we send off daily specially interest them. They feel sure that the unusually long rainless period we had in August had some connexion with the ultimate purpose and fate of the balloons in the high atmosphere and attribute to us a specialized form of super medicine-man technique."

The Development of Colour Films.

By T. Thorne Baker.

An article in DISCOVERY *last month dealt with the possibility of films in three dimensions. Another aspect of modern progress in the cinema is dealt with here. The author foresees the film in natural colours becoming as familiar in the near future as the "talkie" is to-day. An exhibition of kinematography is now being held in London.*

THE long delay in the appearance of the film in natural colours has been due not so much to the lack of a satisfactory method as to the stringent conditions imposed by the industry. Already the arc lamps used for projecting black and white pictures in big theatres are about as powerful as is practicable, and a coloured film which requires more light is thus ruled out. Many processes which have given most promising results have required some sort of attachment or optical device to be added to both camera and projector, and this again has been prejudicial to their adoption. Finally, the added cost of colour must be practically nil, otherwise both producer and exhibitor, while maintaining a most critical attitude regarding the question of quality, will complain that its cost is prohibitive.

Few who are not associated with the film industry recognize the remarkable degree of photographic perfection which the modern film has reached. This again has made the work of the natural colour investigator more difficult, for his pictures must not only be faithful, inexpensive and simple to take and exhibit, but their artistic quality must be of the black and white standard, and they must, of course, have sound!

The motion picture in colour has been developed along three principal lines, which will be briefly discussed, though it must be understood that a very large number of alternative methods are being pursued. Many of the latter are two-colour systems, in which an attempt is made with two primary colours instead of the three dictated by physiological requirements, to produce the myriad hues of the visible spectrum. By adding together different proportions of *three* primary colours, blue-violet, green and red, it is possible to imitate any individual colour; and this is equally possible by subtractive methods, using the complementary colours of yellow, magenta and bluish-green.

The Colour Era.

The colour era has begun. The amateur photographer can already take pictures in natural colours with a simple hand camera operated by an internal spring motor, and these can be projected on the screen with fascinating results. The sub-standard film, which is 16 mm. wide as against the 35 mm. of the theatre, is non-inflammable, and is being adopted for educational and advertising work as well as for home entertainment on an astonishingly large scale. The familiarity with motion pictures in colour which the sub-standard pictures will bring about, will naturally strengthen the popular demand for the colour film in the cinemas.

New Methods.

Two additive systems have been developed recently. One involves coating the film base with a geometrical arrangement of blue-violet, green and red rectangular areas of approximately one-millionth of a square inch each in area. This matrix acts as a microscopic analyser of the colours of the subject, and when the sensitive emulsion which is coated upon it is exposed in the camera, with the matrix facing the lens, microscopic deposits of silver are formed on development wherever the light has been transmitted by the coloured units. When such a film is developed and reversed—so that the image is positive—the silver which has been deposited behind any coloured square is dissolved out, so that this area of the image is now transparent, and the colour is seen through it in its correct position to the eye. The result is a composite picture in natural colours of the type well known to us in the form of Autochrome and Agfa screen plates, which have, of course, been available for many years.

Why has natural colour film base on these lines been so long in coming? Work has actually been proceeding in this direction for more than a decade, but it is only recently that a method has been perfected of producing film base of the standard width of 21 inches in continuous lengths of many thousands of feet at a cost which, as already indicated, is almost negligible. The cycle of operations involved in producing this coloured matrix is simple enough in itself. The base is first coated with a layer of collodion dyed with the primary green dye. Thousand-foot lengths of this film are then passed through a rotary printing machine, which prints on the surface parallel lines $\frac{1}{500}$th of an inch wide and equally spaced. This ink is allowed time to dry sufficiently to enable it to resists the effect of a bleaching bath through which the film then passes, the result being that the green colour is washed out of the spaces in *between* the

lines. The film then passes through a red bath, which dyes the bleached spaces the primary orange. Finally, the printing ink is removed by suitable solvents, when the green collodion which the lines had protected is

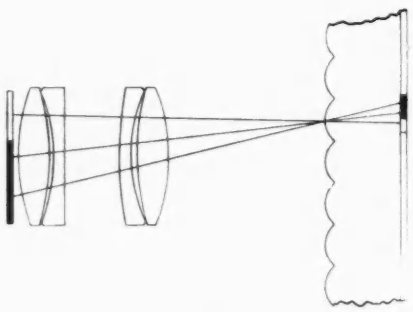

FIG. 1.

A diagram showing the formation of the image of the three-colour filter, formed on the emulsion by lenticulation.

again revealed, and we are left with a series of alternate green and red lines 1,000 to the inch. The film leaves the machine perfectly dry, and it then immediately passes through a duplicate machine in which blue-violet lines are made to appear at right angles to the first series. The result is a matrix of chessboard pattern, which has only to be coated with a fast panchromatic emulsion to be ready for use in any suitable camera.

The method used in the Kodacolor films, which are now well known to amateurs, is that originally devised by a Frenchman, Monsieur Berthon, and, although it involves the three-colour principle, it is purely optical, and the film which is both taken and projected is itself black and white. When a transverse section of the film is seen, it will be noticed that on the side opposite the emulsion is a series of embossed cylindrical lenses. The film while in a semi-plastic state is passed between rollers which mould one surface with these lenticular rulings, each of which acts in exposure as a microscopic lens. When a picture is taken, a filter is placed on the camera lens divided into three parts as shown in Fig. 1. These parts are filters of the three primary colours. The positions of the filter, the lens, the lenticular ruling, and the emulsion are so arranged optically that a triple image is formed of every single part of the subject in microscopic fashion in the emulsion. Thus a red object, which will be filtered out by the green and blue elements of the screen, will not be recorded in the emulsion, except in the red spacing; an orange object would be recorded in both green and red spacings, while a purple object passing through the blue and the red elements on the screen would be recorded in these two spacings, and so on. The film is developed and reversed so as to become a positive, and it is then projected in a lantern fitted again with the tripartite lens filter, which, of course, bears the necessary relation as regards optical position to the other parts. The result is that the picture is reconstructed on the screen in natural colours, and a delightfully simple method of kinematography is thus offered by the process.

We come next to the subtractive process, which has been familiar to picture-goers in the many Technicolor films shown in this country. In the subtractive method three films must be exposed simultaneously through the three primary filters. From the three negative records in black and white so obtained, three positive images must be made in the complementary colours, yellow, magenta and blue-green, which must be superimposed in exact register on the one film base.

As already stated, there are many variations of both additive and subtractive processes, but we are confining ourselves in this article to the methods which have gained practical consideration. In the Technicolor process the old effort of dodging the cost and mechanical complication of taking three pictures was resorted to, and it must come as a surprise to many that the beautiful results which have been shown in Technicolor have so far been obtained with only two primary colours. The process is, however, being modified to embrace the three primary colours, with an immense improvement in the results.

Commercial Processes.

One method by which negatives may be taken is seen diagrammatically in Fig. 2 (left). The rays of light pass through the camera lens and are divided into three paths; in one case the rays pass direct to the film, in the other two cases they are deflected to the side of the central picture by prisms, so that three images, P1, P2 and P3, identical in size and perspective, are obtained. The cube in Fig. 2 (right) indicates a method of obtaining two films by a two-colour process. Here part of the light goes to the first film, P1, while part of it is reflected by a semi-silvered base of one of the prisms which go to make the cube, and falls upon the second film P2. In such two- and three-colour processes one disadvantage is obvious, *i.e.*, that two or three films are required, as against the one film needed for the additive processes described. There is also the difficulty of exact register and of colour fringe.

One method of making the subtractive print which has proved commercially practical is by the use of a double coated film base, on one side of which is coated

a green sensitive emulsion, on the other a red sensitive emulsion. By an ingenious optical printer the two negatives are printed on to the two sides of the film simultaneously, giving two black and white images, records of the bluish-green and orange sensations, which have in turn to be converted into *coloured* images by one of the methods well known to-day. The number of ways in which pictures in colour can be made from a black and white image increases.

When we come to the additive systems already described, new difficulties step in. If the embossed lenticular film is copied on another embossed film, the lenticulations, being so minute, give rise to interference or "watering," which causes grave defects in the quality of the copy. The copy must perforce be composed of composite colours, and as each colour in the original is no longer a continuous tone, but is itself made up of different proportions of microscopic blue, green and red elements, a distinct lightening of the hues results. It has been found difficult so far to make duplicates of the same brilliancy of colour as the original, combined with a perfect range of intermediate colours and perfect photographic gradation. The same type of difficulty is met with in copying the geometrical colour matrix. Here, by means of new optical devices, it has been found possible, in the case of the Spicer-Dufay film, to bring the duplicates to a state of considerable perfection. The means by which both lenticular and geometrical matrix duplicates are made are naturally for the time being somewhat of a confidential nature, but recent

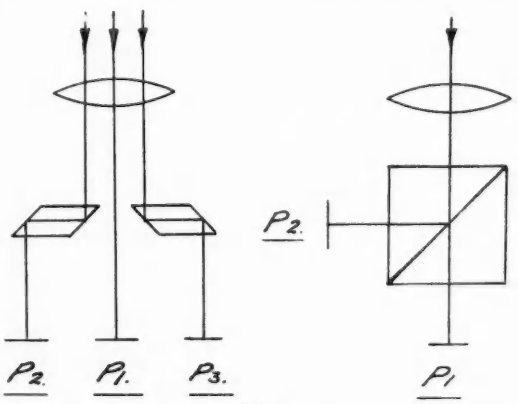

FIG. 2.
(Left) Three-colour analysis. (Right) Two-colour analysis by means of a cube made by two right-angled prisms.

progress has been such that no doubt exists of the motion picture film in natural colours becoming as familiar to us in the near future as the talking picture is to-day.

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The Earliest Americans.

How and when man reached America are questions which have long been posed by anthropologists, but for which no complete answer has yet been given. It is generally agreed that the earliest Indians were of north-eastern Asiatic origin and entered America at a time when they were hunters, unacquainted with the potter's wheel; if they practised agriculture at all, it could be only in its most rudimentary form. Nor is it certain how they reached the continent. No remains of early man have been found in America uncontestably of an age which would have made it possible for them to have used a pleistocene land-bridge joining Asia and America.

Studying the Eskimo.

In the hope of obtaining evidence which would throw light on the questions in doubt, the Smithsonian Institution of Washington has sent out annual expeditions to north-west America during the last six years. Ancient habitation sites have been excavated and observations have been made on the physical characters of the present-day Eskimo. The work has been conducted over the area extending from Point Barrow, along the western coast of Alaska, to Kodiak Island, as well as on the principal islands of the Bering Sea. A large number of abandoned Eskimo sites have been examined, the settlements varying in size from a few families to some hundreds of individuals. Most of them died out after the coming of the Russians; but the expeditions, digging down through village refuse, often fifteen to twenty feet thick and showing no trace of European influence, found strata belonging to archaic cultures. A remarkable example of Eskimo art is a stone lamp, thought to be ceremonial in purpose. This has been found at Kachemak Bak, Cook Inlet, by Miss F. de Laguna during the past summer. In the bowl of the lamp is a carved human figure. It belongs to the last phase of prehistoric Eskimo settlement, and with four other known examples, forms a unique class in Eskimo art.

Dr. Ales Hrdlicka, summing up the results of the expeditions in a communication to the American Philosophical Society, expressed the opinion that the oldest Eskimo culture, made known by these excavations, does not go back beyond a thousand years. It is clear that when once man had arrived on the north-east coast of Asia, it was inevitable that he should pass over to the opposite and clearly visible shore of America. Nor is the postulate of a land-bridge an essential. The passage by sea would have been easier, even had a land bridge been available.

The Discovery of "Braggite."

By F. A. Bannister, M.A.

Assistant-Keeper in the Mineral Department, British Museum (Natural History).

A new platinum mineral has been discovered at the British Museum among crystals sent from the Transvaal. This is the first mineral to be determined by X-ray methods, and has been named "braggite" in honour of Sir William Bragg and his son Professor W. L. Bragg, the pioneers of this method of investigation.

ONE of the most valuable storehouses of mineral wealth in the British Empire is confined within an oval area occupying about 15,000 square miles in the centre of the Transvaal. The whole of this area, composed entirely of plutonic and volcanic rocks, is known as the Bushveld igneous complex. The greater part of the periphery of the oval is fringed with quartzite reefs, and the famous Rand gold-fields are located in the southern portion of these reefs near Pretoria.

Platinum in South Africa.

The monotonous stretches of veld north of Pretoria are only broken here and there by conical hills and rugged kopjes. Farming is carried on in the better irrigated portions of the Bushveld and it was on a farm in the Lydenberg district that Dr. Hans Merensky discovered the platinum horizon that bears his name. The late Dr. Percy Wagner in his classic work "Platinum Deposits and Mines of South Africa" states that "the deposits on this horizon are among the world's greatest concentrations of mineral wealth and among the most remarkable." Merensky followed up his discovery of 1925 by tracing the horizon over a total length of more than 300 miles. His work placed the exploitation of the South African platinum lodes upon a sure footing. By 1928 South Africa had gained the third place among the world producers of platinum. Russia was then the first and Columbia the second on the list.

The platinum-bearing rocks of the Bushveld are mainly basic igneous rocks called norites, which form a huge basin-shaped sheet on the outer and lower portions of the oval area already mentioned. The norites contain pipes and parsnip-shaped masses of a still more basic rock, dunite, which is composed almost entirely of coarsely crystalline iron-rich olivine. The platinum ore content of the dunite pipes is high and consists chiefly of metallic platinum alloyed with palladium and iron. The unique platinum occurrences of Russia are alluvial and the metal is relatively easy to extract. The rivers and streams of the Ural mountains have from remote times concentrated the heavy platinum by washing away the lighter constituents.

In the Transvaal mining engineers are confronted with the task of winning one ounce of platinum from at least 500 times that weight of hard compact rock. The account of initial failure, repeated endeavour and ultimate success forms one of the most interesting chapters in the history of mining. The ore is mined at various depths down to a 1,000 feet, crushed by machinery, and passed through a succession of operations which free the metallic platinum from the lighter mineral constituents of the mother-rock. We have already referred to the occurrence of metallic platinum in the dunite pipes. In addition, the norites contain an appreciable percentage of various crystalline compounds of the platinum metals with sulphur, arsenic, and antimony.

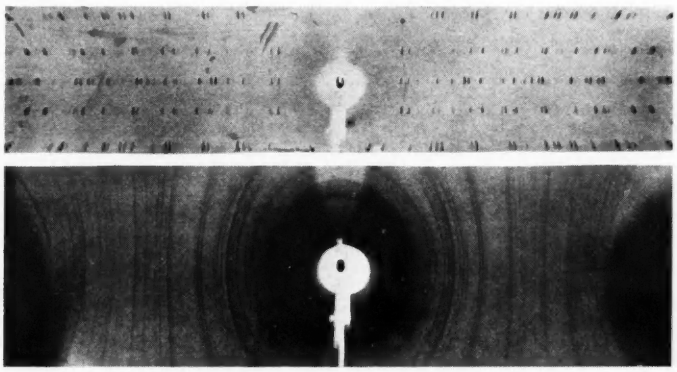
There is yet a third source of platinum in patches of primary sulphide ores of iron and nickel which are also found scattered through the unweathered norite. Thus in addition to concentrating the crushed ore, further processes such as smelting or chlorination must follow if the highest platinum returns are to be obtained. The necessity of treating chemically some of the Bushveld platinum ore led to most interesting discoveries by the South African mineralogists and chemists, and upon their careful studies depended the ultimate separation and identification by X-ray methods of a new platinum mineral.

Many Uses.

There are six metals belonging to the platinum group, platinum, iridium, osmium, palladium, rhodium, and ruthenium. Of these, platinum, palladium and iridium have the greatest economic importance. Large quantities of platinum and palladium are used in jewellery and both metals are employed in the chemical industries and in dentistry. Sparking points are often tipped with platinum-iridium alloy and the other three platinum metals are frequently utilized in the electrical industries. All six are remarkable for their resistance to chemical attack. They do, however, dissolve in *aqua regia*, a mixture of nitric and hydrochloric acids containing free chlorine. They readily alloy with each other and with other metals so that native platinum is rarely pure. The Bushveld platinum, for instance, is alloyed with some palladium and iron.

The naturally occurring chemical compounds of the platinum metals are few in number. Until recently only two were known, sperrylite, a compound of platinum and arsenic from Ontario, Canada; and laurite, ruthenium sulphide, from Borneo. Sperrylite dissolves much less readily than platinum in *aqua regia* and laurite is quite insoluble. When concentrates from the platiniferous norites of the Bushveld are treated with *aqua regia* all the metallic platinum is removed. Prolonged treatment will also dissolve some very brilliant but tiny octahedra of sperrylite. These rarely measure more than 1.25 inch (1 mm.) across. The Bushveld deposits have, however, yielded the two largest crystals known to science. The larger one weighs just over an ounce (33.8 gm.).

Having dissolved out all the platinum and the sperrylite from the concentrates there are still left some fragments which are quite unattacked. They all look alike to the naked eye, and have a steel-grey colour. These residues first attracted the attention of R. A. Cooper who analysed a sample and found that they contained platinum, sulphur and some palladium. Native sulphides of platinum metals had never been detected before. Cooper had discovered a new platinum mineral, the first since 1889. A little later the residues insoluble in *aqua regia* were named cooperite in recognition of Cooper's pioneer work on the minerals of the Transvaal deposits. It was not suspected that this name covered a mixture of at least three distinct minerals.



X-RAY PHOTOGRAPHS OF BRAGGITE.

(Above) A rotation photograph, showing the arrangement of the spots in layer lines. (Below) A powder photograph; the powdered crystals are attached to a thin glass fibre and this is placed vertically in the X-ray beam.

Through the kindness of Mr. H. R. Adam the Potgietersrust Mining Company sent samples of the so-called cooperite to the British Museum (Natural History) for further investigation. The fragments differ considerably in size according to their position in the platinum lodes. The largest Mr. Adam could obtain are about the size of the head of a pin. One or two show crystal faces suggesting cubic symmetry, but the external form of most of the fragments is quite irregular and gives no clue as to their nature. By using X-rays, however, the internal structure itself can be revealed and tested for each fragment in turn. Such a method was invaluable in the present instance, where the original cooperite proved eventually to consist of at least three distinct minerals.

During the course of the X-ray work, Mr. A. N. Coussmaker, working in the laboratories of Messrs. Johnson and Matthey, found that fragments of Cooper's original material exhibited two different colours after roasting in air. The chemical formulae that he deduced for the two components thus separated by colour difference are in partial agreement with the results of the more sensitive X-ray method now to be described. One of his components, however, was probably a mixture of at least two minerals.

X-ray methods of studying crystals can be readily understood if one is acquainted with the phenomenon of diffraction. Everybody is familiar with the reflection of light by mirrors and the bending or refraction of light by lenses. The phenomenon of diffraction or scattering of light by a body in certain directions is not so familiar. The wings of many butterflies and insects owe their brilliant colours to this effect. A gramophone record, held a few feet away from a bright light and viewed almost edge on shows a coloured spectrum. Superposed on this, of course, is a white streak of light reflected from the disc no matter at what angle the disc is tilted. The surface of the disc is made up of a very regular succession of ridges and hollows and if they are sufficiently close together they will scatter the light only in certain directions. The angle at which the gramophone record must be tilted to see the spectrum depends on the spacing of the ridges and on the wave-length or colour of the light.

It has been found that diffraction effects can only be observed when the distance between two ridges is about the same as a wave-length of light. Nearly all solids are crystalline, that is, their atoms are arranged, not only in parallel ridges and furrows on the surface, but are built into a beautifully regular structure in

which electrical forces play the part of unseen "girders" and "walls." The distance between two layers of atoms in such a structure is so small that it can only produce diffraction effects with a beam of light of very short wave-lengths, namely X-rays. If we use a beam of X-rays of known wave-length, we can investigate the spacings between layers of atoms in an unknown crystal, in any direction, providing the spacing is not so large that the spectra are huddled too close together for measurement. Each atom acts as a scattering unit and scatters a quantity of X-rays roughly proportional to its weight.

Photographing Invisible Beams.

When a crystal is slowly turned around a known axis in a beam of X-rays the scattered radiation is composed of a sequence of invisible beams of varying intensities. These diffracted beams can be received on a photographic plate of film protected from ordinary light by a black paper envelope, each beam producing a black spot on the developed negative. The direct beam throws a shadow of the crystal in the centre of the film. The photograph (above) is a reproduction of such a photograph and shows how the spots are arranged in layer-lines. The pattern obtained is an identification far surpassing in certainty any other test that can be imposed. Not only will that crystal, orientated in the same direction, always yield the same pattern but any crystal of the same mineral, however small, will yield identical photographs.

X-ray photographs can be obtained with very simple apparatus. The crystal is set on the top of a spindle rotated uniformly by a clockwork motor. If the crystal has natural faces developed an edge common to two of them is set vertical. A cylindrical camera is used because a more extended pattern is obtained than is the case with a flat film or plate. The X-ray beam is limited by pin-holes to a narrow, slowly diverging cone in which the crystal is accurately centred during rotation. The rotation photograph reproduced required nearly an hour's exposure.

The powder photograph (below) is obtained with the same apparatus, but powdered crystals are attached to a thin glass fibre and this is placed vertically in the X-ray beam; it need not be rotated if the crystals have been finely powdered. In this type of photograph the tiny crystals making up the powder are pointing in every conceivable direction, but diffraction can only take place in a finite number of those directions, a number governed by the wave-length of the X-rays and the spacings in the crystal. Whereas in the rotation photograph, one spot corresponds to one direction and one spacing in the crystal, on the powder photograph each ring corresponds to a spacing.

It is an important fact that the rotation photograph of one crystal about any direction will always be superposable upon the photograph of powdered crystals of the same mineral. Each spot of the first photograph falls exactly upon a ring of the powder photograph. This would be equally true of an X-ray photograph of a fragment of the same mineral rotated about any direction. The spots would no longer form layer-lines but the photograph could still be superposed upon the powder photograph. A fragment of any mineral can be readily identified by this method providing a "master" powder photograph is available for comparison.

It is now possible to describe how X-rays detect and sort out with unerring accuracy the separate minerals from a number of opaque fragments. The samples of so-called cooperite received from Mr. Adam contained a few small cubic crystals. A rotation photograph of one of them was first taken and showed conclusively that the mineral was not sperrylite. In order to check the composition of the fragments a powder photograph was then obtained. The rotation photograph of the cubic crystal could not be superposed upon the second photograph. In this way it was discovered that Cooper's material must include more than one component. A large number of rotation photographs, each of a separate fragment, in turn were then taken and compared with "master" powder photographs. Thus it was possible to divide the original sample of cooperite into three small heaps, which may be labelled for convenience A, B, and C. X-ray photographs of all the particles in heap A are identical, but quite different from B or C photographs, and so on.

Micro-Chemical Analysis.

My colleague, Mr. Max H. Hey, kindly undertook the micro-chemical analysis of each tiny heap. The first proved to be laurite, ruthenium sulphide, which hitherto has only been reported from the gravels of Borneo. It occurs in perfect but small tabular crystals, quite insoluble in *aqua regia*. The number so far found in the samples of Bushveld concentrates sent to England is only six. Heap B, composed entirely of irregular fragments, sometimes rounded in shape, was found to be platinum sulphide—the name cooperite has been retained for this compound because its formula corresponds closely to Cooper's for the original mixture.

The third heap, labelled C, contained small square prisms up to 1/20 inch (1.3 mm.) in length, sometimes capped with rounded faces. These crystals have a

brilliant metallic lustre like those of sperrylite. Four fragments shown by X-ray photographs to belong to the same heap and weighing only a minute fraction of an ounce (ten milligrams) were skilfully analysed by Mr. Hey. He concluded that the mineral is a platinum sulphide containing considerable palladium and a little nickel. The chief difference between the chemical composition of cooperite (heap B) and the mineral (heap C) is the content of palladium. The latter contains eighteen per cent and the former less than three per cent of this metal. This alone is not sufficient evidence to justify the use of two distinct mineral names for B and C.

The New Mineral.

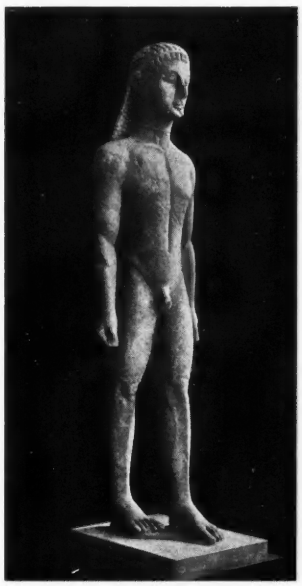
An X-ray photograph of a crystal from heap C is shown in the photograph (above). It possesses an entirely different pattern from that of a crystal from heap B. In other words, their crystal-structures are quite different. Imagine some of the atoms of platinum in the simple cooperite architecture being replaced one by one by atoms of palladium (which are rather smaller). All goes well for a time, and then quite suddenly the structure undergoes some radical weakening of the "girders" and "walls," and the atomic pattern of cooperite no longer exists. It now passes into a more stable pattern with different dimensions. A discontinuity exists between the crystal-structures of these two minerals. X-ray methods therefore have revealed the existence of a new mineral, distinct from cooperite. X-rays have isolated it, shown that it possesses a new structure and separated enough for chemical analysis.

It is well known that Sir William Bragg and his son have unravelled the intricacies of the atomic architecture of large numbers of crystalline organic and inorganic substances. They have also developed the necessary technique upon which has been founded the application of X-rays in this and many other fields of scientific research. This new mineral, the first to be discovered by X-ray methods, has therefore been named "braggite."

The Bushveld deposits have yielded crystals of all the compounds of the platinum metals yet discovered; and there still remain fragments giving X-ray photographs which have not yet been identified. The elucidation of the crystal-structure of cooperite and braggite is also not quite completed. There lie in the relations between these minute architectures, solutions of many problems and explanations of interesting facts which puzzle the mineralogist in his laboratory and the mining engineer in the field.

A Marble Statue from Attica.

THE most important archaeological discovery of the last few months is a work of art which must rank as the most impressive found in Greece for the last generation. It takes the form of a new acquisition to the Metropolitan Museum, New York, and is an almost perfectly preserved male statue in Island Marble from Attica. It is the earliest Attic statue known dating to about 600 B.C., when Attica was controlled by an aristocracy of old Ionian families, and before the reforms of Solon. As such, it throws revealing light upon the wealth and culture of Athens at a period when history has little to tell.



THE MARBLE STATUE.

It is also remarkable that there is in the National Museum at Athens a head, found in the Dipylon cemetery, which is almost the exact replica of the head of this statue, of the same scale and almost certainly by the same sculptor. This at least places its Attic origin beyond all doubt. Both figures stood about 6 ft. 4 ins. in height. Both combine to form a group of works which can now be isolated as Attic work of the earliest period. The well-known "Apollo of Sunium," now at Athens, is a colossal figure, which belongs to the same circle of artists. The attitude of all the male figures of this group is, in origin, derived from Egyptian sculpture and it is known that Athens even at this early period had trade connexions with Egypt. But the Egyptian influence begins and ends with the borrowing of an attitude.

Further light is thrown upon an even earlier period of Greek sculpture by the discovery in the island of Thera of the upper part of a statue which belongs to the seventh century B.C. and is in the Cretan manner. It resembles the well-known dedication of Nikandra's seventh century statue found at Delos and now at Athens. Neither the new Theran fragment nor the Delian statue have any connexion with the style of Athens.

Watching Bird Roosts.

By E. M. Nicholson.

Until quite lately the roosting habits of birds excited only a faint interest even among those most active in field ornithology. It is an encouraging sign that the roost has now been recognized as the key to many problems. The call for volunteers to assist this winter in a census of British starling roosts emphasizes the importance attached to these investigations.

One of the advantages of bird roosts as a subject of observation is that they are to be found in almost all parts of the British Isles; another that they reach their fullest development between December and March, when many other subjects are dead. It is even probable that the observer in a large town has an actual advantage in this direction, through the greater scale and definition which roosting movements assume in humanly populous areas. To survey the subject at all satisfactorily is not yet feasible, but it seems worth trying to indicate some of the conclusions reached so far, in the hope that other observers may be stimulated to check and amplify them.

The Starlings.

The largest and most notorious bird roosts in England are formed by the starling. Starling roosts are occupied in some cases throughout the year, but the strength and character of the attendance varies. During the breeding season it appears that males are in a very heavy majority, such females as are present being probably either non-breeding birds or birds whose nests have been destroyed. From June onwards the new generation of starlings, with the rest of the adults, brings a great accession of strength, and in some areas impressive roosting flights may be seen by midsummer. But the starling is one of the principal European migrants along an east-to-west route, and by late September birds from all the Baltic countries, including northern Germany and western Russia, are pouring in along the whole east coast of Great Britain.

While at least a minority of the native birds take little or no part in large-scale roosting, these immigrants appear to favour mass dormitories of immense size. An indication of this is the fact that great starling roosts have been recorded for many generations—there was one on Lundy Island over three hundred years ago—in areas where the starling has only stayed to breed within recent times.

Starling roosts are noticed by many people whose interest in birds is slight. While it is uncommon to meet half-a-dozen robins together, and such abundant species as the chaffinch, house sparrow and meadow pipit rarely gather in flocks of more than a few hundred at most, starling roosts attract the largest mobs of birds normally to be met with in England, running into tens or even hundreds of thousands. Wynne-Edwards, who surveyed 3,000 square miles of Devon and Cornwall for starling roosts, estimated the number of starlings among eleven roosts existing in that area as being "of the order of five millions," the largest roost (at Gittisham Hill, near Honiton) being estimated between 500,000 and 700,000, and others between 50,000 and 250,000 birds. But it must be pointed out that Wynne-Edwards himself qualifies these estimates as "almost entirely conjectural," and puts them forward as reasoned maxima in order to demolish the absurd figures frequently suggested.

At one roost this autumn I was informed by the keeper that by Christmas numbers would be up to between forty and fifty million, which, after all, is more than half the probable bird population of all species in England and Wales. The local policeman informed me I would see "billions of starlings" at sunset; there were, in fact, between 10,000 and 20,000 birds. Such wild guesses are not, unfortunately, confined to uneducated laymen: skill and a conscience seem to be rare possessions among those who estimate numbers at a roost.

The very high figures mentioned by Wynne-Edwards are perhaps explicable by the fact that his survey was made in the memorably cold January and February of 1929, when temperatures below zero Fahrenheit were recorded in England. The effect of hard weather is invariably to drive such wintering species as starlings in abnormal numbers towards the south-west, and it would be rash to assume that the concentrations observed by Wynne-Edwards can be treated as normal figures for either Devon or anywhere else. It is interesting to note that during the following winter in Somerset Wynne-Edwards found the population much smaller, although he does not seem to have taken this possible explanation into account.

A New Census.

Repeated enquiries suggest that a good many observers in different parts of the country are eager to help in the important work of clearing up outstanding problems about starling roosts, and the inauguration this winter of a starling roost census by Mr. B. J. Marples of the Zoology Department, Manchester University, supplies a useful focus for effort. In

observing roosts it is desirable to take the largest practicable area on which all the roosts can be located. Some transport facilities, if only an ordinary bicycle, are essential. Enquiries from likely persons should be used to supplement what is learnt by direct observation. It is essential to have time for the work between say an hour before and an hour after sunset on a fair number of afternoons during December, January and February at least.

In the Field.

The observer takes up position somewhere commanding a good view, if possible on a line where starlings are known to fly, and notes the exact direction of passing birds. After doing this from two or three points, it is usually possible to produce the lines with a certainty that the roost will be found pretty close to their intersection. When the flylines prove not to point in the direction of the roost the circumstances should be closely investigated. The commonest cause of diversion seems to be steep hills in the way, but there may be others. Having located the roost or roosts, the observer should try to find out for how many years the birds are known to have used it, whether they use it all the year round or all the winter, or for a shorter period, and whether the period of use varies from season to season. He should also investigate the directions from which birds come in, in order to discover the extent and shape of the feeding-area serving the roost.

Relations between the roosting starlings and other animals (including man), the nature of the roost site and any damage inflicted on it, the times of arrival and departure and the habits of the birds at different seasons are among other evident subjects for study. If enough observers volunteer to make the starling roost census a success, particularly in eastern and northern counties where little has yet been done, our knowledge of the subject may soon become considerable. As it is, there are serious uncertainties and gaps, in spite of the excellent work lately carried out.

Roosts of rooks and jackdaws, often combined, are only less conspicuous than starling roosts because the number of birds assembling is usually smaller. There are, all the same, many substantial dormitories all over the country, and surprisingly little has yet been done to investigate them, with a few exceptions. The fact that rook roosts are often also rookeries, at which a small fraction of the roosting birds stay to breed, makes the early spring situation particularly interesting. But rook roosts call for especially patient and resolute observers, because of the long delays which many of the parties make, hanging about in trees as if they intended to stay the night and suddenly leaving when it is nearly dark. Ravens and carrion crows have remarkably large roosts in districts where they flourish : in January I have counted forty-two crows in the air together at dusk over Ken Wood near Hampstead.

Wintering fieldfares and redwings make considerable roosts, of which little seems to be known. Until very lately the fact that large roosts of pied wagtails occur was almost overlooked and it was a surprise to many ornithologists when one was described and photographed by Irish bird watchers in a little group of plane trees in O'Connell Street, the principal street of Dublin, the winter before last. Last winter numbers rose to between 1,000 and 1,500 wagtails, and a fair number continued using the roost up to the time when the street was floodlit for " Congress Week " in June.

House-sparrows, chaffinches, greenfinches, yellow-hammers, wood-pigeons and gulls of several species carry out considerable movements to the roost, while the familiar flighting of duck and geese only differs in the fact that they tend to feed by night and rest by day. The scale of these movements is illustrated by a recent incomplete list made at Slapton Ley, S. Devon, of the various movements towards dusk :

(*a*) Incoming to Slapton roost—starlings from N. and W., pied wagtails from close at hand.
(*b*) Outgoing from Slapton roost—mallard to River Dart.
(*c*) Outgoing to Start Point roost—herring and greater-blacked gulls.
(*d*) Outgoing to Dartmouth area roost—herring gulls.
(*e*) Passing to unknown roost—jackdaws going W.
(*f*) Gathering in roosts near foraging areas—coots, carrion crows, etc., etc.

An equally important array of fly-lines could be mapped in many other places, including central London.

Social Organization.

While the tracking down and mapping of roosts is often great fun to the people concerned, its ultimate value to biology depends on the use of the data gained in exposing the significance of the roosting habit, and in giving us a firmer grasp of the social and economic organization of birds. Undoubtedly the big roost is the result of a complex of basic forces which have hardly yet been probed. Wynne-Edwards has even found evidence to suggest that the order in time of awakening and exodus from the roost of the various flocks is dictated by the state of their sexual development, the earliest risers being the most

advanced, and the latest being probably so backward that they will not breed in the ensuing spring.

Here the roost makes contact with migration, for these same obscure responses to light are strongly suspected of regulating the migratory impulse. But the roost has another link with migration, for in the case of starlings it seems to be Continental immigrants that form the largest British roosts, while some of the native birds may sleep singly or in pairs or handfuls throughout the year near their own chimney-pot.

The actual determinants of the snowball process by which large roosts are filled seem to be partly physical and partly psychological. Socially any species has four limits on its density of concentration: (*a*) limit of numbers which can rear broods on a given area; (*b*) limit of numbers for foraging in company; (*c*) limit of numbers within a range in which daily assembly is feasible; (*d*) limit of occasional assembly (*e.g.*, on migration).

Different limits are predominant at different seasons. In the breeding season, evidently, (*a*) is paramount. But given that fifty pairs of a certain species can find food on two hundred acres, (*a*) does not decide whether they must live on separate territories, or communally. That is settled by their mobility, frequency of suitable nest-sites, sociability and other factors. On the other hand (*b*), the limit of numbers for foraging in company, is normally valid all the year round, although it may expand or contract according to food resources. (*b*) is a limit about which little is known, except that it is liable to be very much smaller than (*c*) in any given case.

Foraging Parties.

With the starling, for instance, the limit of successful foraging parties may in some areas at least prove as low as fifty or sixty birds; more than that cannot usefully hunt together, but tens or even hundreds of thousands may assemble at the roost, the only limit here being the number of foraging parties which can exist within a short enough radius of a central rendezvous to be able to fly into it for a rest. As the maximum time which can be spared for the journey each way is generally well under an hour, and the speed of normal flight somewhere between twenty-five and forty miles as hour, it follows that a bird roost is unlikely to exceed whatever number represents the population for 1,250 square miles—that is, the approximate area of a circle of twenty miles radius.

Applying this in terms of ordinary English densities, the maximum for a rook roost in normal circumstances ought to be between 25,000 and 30,000, while a very rough estimate for starlings gives a maximum of about 300,000. It is just possible that in the exceptional conditions of 1928-9 this maximum may have risen substantially in the south-western counties owing to concentration under pressure of climate, but I personally remain sceptical of any figure higher than this.

Fascinating as a large roost is to the least informed of sightseers, its fascination to the bird-watcher is incomparably greater; these converging masses of wings carry the answer, when we can read it, to some of the fundamental questions of life.

"Men of the Trees."

As forestry officer in Nigeria and Kenya since the war, Captain Richard St. Barbe Baker has had to identify and test the value of the forest trees as well as organize and carry on the work of conservation. In this last his duties were made more difficult by the destructive methods of agriculture of some of the native tribes. In a new book* he tells the story of his ingenious utilization of native custom and ways of thought, whereby their interest was turned to the preservation of the forest and the planting of young trees instead of to its destruction. It is an invaluable object lesson of the place of sympathy with the native point of view in administration, and fully bears out the often expressed views of anthropologists on methods of governing and educating the native.

Captain Baker's account of the forests and timber of Kenya and Nigeria, much of which is of high potential value, is not a scientific treatise on forestry; but it gives the reader an insight into the duties, methods and responsibilities of the forestry officer; while his estimate of the value of the timber resources of Kenya will probably come as a surprise to those readers upon whom its advantages as a country for planters and agricultural settlers have been more strongly impressed. In the course of his duties the author has traversed country and encountered tribes off the beaten track. Of these and their often curious and remarkable customs he gives an account which would do credit to a trained anthropologist. Captain Baker is gifted with an exceptional capacity for sympathetic understanding of the native. From this racy, and in many ways unconventional, narrative much may be learned of the tropical forests of Africa and their potentialities, as well as of the ways of the natives who dwell in them.

**Men of the Trees.* By Richard St. Barbe Baker. (Allen and Unwin. 12s. 6d.)

Correspondence.

THE LAYMAN AND THE UNIVERSE.

To the Editor of DISCOVERY.

SIR,

Many of us must be grateful to you for giving space to letters from those who, though laymen, are deeply interested in natural philosophy. The letter from Major Stenhouse, in the November issue, suggesting a modern version of Cartesian eddy systems, encourages one to enquire whether the whole classical conception of aether is really obsolete?

There are facts of astronomy which fitted exactly into the picture of a fluid space, and which have not yet been fitted for us into the new picture. For instance, when a sphere is rotated in a water eddy, all particles move towards the equatorial plane of the sphere, and they revolve round the sphere at different velocities according to their distance, making a crude model of Kepler's Law; here, the classical picture explains why satellites always keep near the equatorial plane of the primary. The spiral shape of nebulae fits well into the picture; the conception of an extensive solar eddy also suggests the shift of a light-ray grazing the Sun. But the greatest loss is the classical picture of gravitation. The path of an object falling to earth looks vertical to us, but it is actually a spiral; at the Equator it is a flat spiral, at the poles it is a corkscrew, and intermediate forms occur at intermediate latitudes; this fits beautifully with classical theory and with applied relativity. One feels that no adequate substitute has been published.

The reason given for discarding finally the classical theory is "the failure of the Michelson-Morley experiment." But did it "fail"? It did not prove what it was expected to prove, but it did not fail to prove something, namely, that there is no relative movement between the earth's surface and the contiguous space at the point selected for the experiment. According to recently published discoveries of Prandtl and others, if there is an eddy in a fluid round a rotating sphere, then there can be no relative motion in the "Boundary layer" as Prandtl calls it. We live in the boundary layer of the earth, so Michelson-Morley results help rather than hinder the classical picture. What then is the fundamental error in the classical picture which has made it untenable?

Yours faithfully,
C. T. JACOB.

St. Albans,
Herts.

BIOLOGY IN EDUCATION.

To the Editor of DISCOVERY.

SIR,

With the support of Lord Irwin, Lord Chelmsford, Sir E. Hilton Young and the major educational organizations, a National Conference on "The Place of Biology in Education" will be held at British Medical Association House in London on November 30th and December 3rd. Some 7,000 invitations have been issued to the Conference, and membership is also open to individuals.

We believe that the subject of the Conference will be of particular interest to the readers of your publication and we should be glad if you would draw their attention to it. The various departmental and other committees that have considered British education during the last few years have all commented on the serious omission of the biological sciences. It is hoped that the Conference may result in definite action being taken, both by the Board of Education and by the education committees throughout the country, to give facilities for post-graduate training of teachers in biology and to encourage the adoption of various methods of approach to the attainment of a cultural background of these sciences being incorporated in all schemes of general education. The Council believe that a cultural background of biology is essential to the successful adoption of any progressive health policy, and therefore hope to focus attention on the subject through the agency of the forthcoming Conference.

The national and imperial need for a biological outlook will be the subject of inaugural addresses by the President and patrons of the congress. Among the speakers will be Sir Michael Sadler and Sir William B. Hardy. Professor Winifred Cullis is to take the chair at the morning session on December 3rd to be devoted to a study of biology in the elementary schools; while Mr. W. W. Vaughan, lately headmaster of Rugby, will preside over the afternoon session dealing with the public and secondary schools.

A public meeting has been arranged at the Essex Hall, Essex Street, Strand, W.C., on December 1st, at 6.30 p.m., on "Biology and Education." The principal speakers will be Dame Helen Gwynne Vaughan, D.Sc., and Professor A. C. Seward, F.R.S., of Cambridge University. It is thought that many who are unable to become members of the Conference will welcome this opportunity of hearing something of the progress already made in the promotion of biological education and of the possibilities of further development in this field. Admission is free and no tickets are required.

Yours faithfully,
C. NEVILLE ROLFE,
Secretary General.

British Social Hygiene Council,
Carteret Street,
S.W.1.

PURPLE IN THE SPECTRUM?

To the Editor of DISCOVERY.

SIR,

From 6 to 7 p.m. on a recent evening, at Ingleborough, Yorkshire, a strange phenomenon was observed. The writer and two friends were watching the play of a thunderstorm among the hills, when a brilliant rainbow—all its colours of a very great intensity—appeared against the dark storm-cloud; and below the violet was a band of deep purple. The writer has never before seen this colour in a rainbow, nor in any kind of spectrum; surely it has been supposed to be a non-spectral colour? As if to emphasize this unusual appearance, a reflection of the purple band *only*, without the violet or any other part of the bow, appeared inside, and at a short apparent distance below, the rainbow. The cloud between appeared of a greenish colour, no doubt a subjective appearance, green being the complimentary of purple. Above and outside the main bow was also a fine reflection (making a "double rainbow"). The whole formed the most striking and beautiful spectacle that can well be imagined.

Yours faithfully,
MARY BARNE.

Bloxham,
Oxon.

Across the Ice Cap in a Flying Boat.

By Commander Wolfgang von Gronau.

The author was among the first to foresee the practicability of an air route from Europe to America across the Greenland Ice Cap. The late Mr. Watkins' expedition prompted him to explore the possibilities for himself, and the following is an account of his recent flight. It is published by permission of the Royal Aeronautical Society.

My recent flight from List, Germany, to Chicago, via Greenland and Labrador, was the sequel to a similar flight to America in 1930. I then chose the south point of Greenland and became much impressed by this interesting country. Ever since that flight I had a strong desire to explore this country more closely. My desire for a second flight became acute when we in Germany received the first reports of the British Arctic Air-Route Expedition, under the leadership of the late Mr. Watkins. Their weather reports for our prospective flight were very favourable, and I immediately set to work to organize my second venture. I succeeded in obtaining the support and the assistance of the German Luft Hansa, the Association for the Cultivation of German Science, under whose auspices the Wegner Greenland Inland Ice Expedition operated, and also the support of the German Ministry of Transport and the Danish Government.

The trial flight to America of 1930 convinced me that the route via Greenland offered practical possibilities. Of course, the route which I selected at that time over the south point of Greenland did not appear the most advantageous, and I therefore decided to repeat the performance over a different route. This time I intended to avoid long stretches of sea, by flying from Reykjavik to the east coast of Greenland and from there straight across the inland ice to the west coast; thence via north Labrador over the Hudson Bay to the middle west of the North American Continent. As our final goal we selected Chicago, as it is the largest and most important commercial centre in the interior of the U.S.A. Further, our flight was guided by large lakes and rivers and the situation seemed ideal.

NEAR SCORESBY SOUND.

Scoresby Sound is the largest bay on the east of the Greenland coast. After circling about the coast the little houses of the settlement were seen, dotted here and there.

The crossing of the inland ice wastes of Greenland meant a flight of five hours, at a height of about nine thousand feet, over territory which was completely covered with ice and without any sign of life. Although the great inland glacier offers here and there favourable landing possibilities for a seaplane, an emergency landing under unfavourable conditions would have necessitated a tramp of several weeks across the ice to safety. Consequently we had to provide suitable equipment and carry with us the necessary provisions for such an emergency. The risk, however, in crossing the ice regions appeared to me negligible in comparison with other great advantages which are offered by a flight along this route. The proposed stages of the flight were a little better arranged than on the previous occasion, and the stretches of sea selected were comparatively shorter. Arrangements were made to discharge our fuel quickly during the flight in case of emergency. We selected a plane with two engines so that in case one broke down we could carry on our flight for another two or three hours with the remaining one. These facts reduced the risks considerably.

In working out our route via Greenland, we had in mind to explore the possibilities of establishing a regular air route to America and to make a few reconnoitring flights along the east and west coast for the purpose of eventually establishing meteorological stations. We selected Godthaab, the capital town of Greenland, as our main point for these surveying flights. We had previously sent Dr. Baumann, the meteorologist of the German Commercial Flying School, to Godthaab to render us the necessary assistance. The Danish Flight Organization also showed great interest in our enterprise and for its own information had dispatched Mr. Petersen, one of their best known airmen, to Greenland to give us all the necessary assistance. All these preparations entailed a considerable amount of work.

With much trouble and a considerable loss of time the Dornier Wal (a later type of the Amundsen Wal used in the previous year) was at last completed and equipped. The necessary instruments were only delivered at the last minute, and the short-wave radio apparatus, for which we had especially asked, could not be delivered, so that we had to content ourselves with an old heavy model which added unnecessary weight and proved of inadequate use to us on our flight. Further adding to our difficulties, I decided to take a film of the flight. I had selected the same crew as on the previous flight, but not one of us had had any experience in taking films. Strictly speaking, I am not very eager to take photographs on such a flight as it deprives one of a most important item, namely, time. Pictures however, form a real reminiscence of a flight and I stuck to my original idea, equipping our plane with a film camera and the necessary material. This, of course, meant more money, more work and, above all, more weight. Later on we did not regret the inconvenience incurred by taking the photographs.

A TYPICAL SCENE ON THE FLIGHT.

It was frequently difficult to find space on the water sufficiently free from floating ice to permit the safe landing of the plane.

Everything was ready; and then followed what every airman detests—a period of waiting for suitable weather conditions. Fog and storms held us up for several days. Finally we became impatient, grew tired of waiting, and when a temporary local improvement but new depression was forecast, we decided to start. Up to the Orkney Islands we had a steadily increasing head wind, dropping our speed to about eighty miles per hour. When we were over the English Islands, we were able to establish a radio contact with Faroe, from which we learned that the weather conditions there had improved and that, at least for the last lap, we might expect better flying conditions. We safely reached and landed at the already familiar port of Trangisvaag.

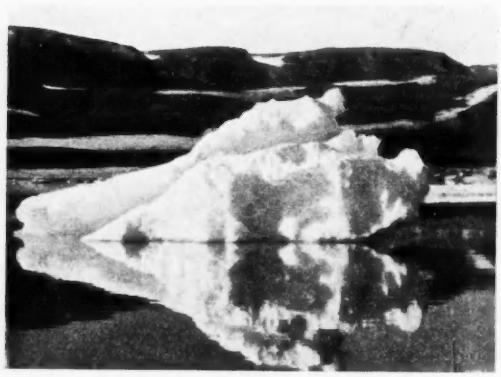
We started the following day in glorious sunshine, but after an hour's flight we ran into a deep depression accompanied by fog vapour, low clouds and fine drizzling rain. The visibility was so bad that we had to descend to within a few feet of the water and pull in our antennae. After an hour and a half the atmosphere cleared a little and we were able to make contact with the Iceland radio station, which informed us that the visibility over the country was fair, but that we must expect strong head winds. Meanwhile, we had made good progress and were no longer so anxiously concerned about our petrol supply. Over our starboard and through the mist and clouds we saw in the distance the summit of the mighty white Vatna Jökul Mountain, and found ourselves immediately off the coast of Iceland. In spite of considerable doubt as to landing conditions at Scoresby Sound, the danger of floating ice and our ignorance as to the possibility of anchoring our plane, we decided to break the monotonous spell of waiting and continue our flight.

As soon as we left the Iceland coast behind us we encountered a wall of fog, and from then onwards fog and good visibility changed at regular intervals. About fifteen minutes' flight from the coast I crawled into the chart-room, when a slip was handed to me containing the laconic word "ice," and upon looking out, instead of the usual sea water, as far as the eye could see we were over floating ice. At first it was thin ice, which became thicker and heavier as our flight continued. Now and then a stretch of fog would obscure our view. We had to go up higher to clear heavy banks of fog, and when we emerged from them we were suddenly confronted by the high mountains of the east coast of Greenland, bathed in brilliant sunshine. It was a most impressive sight. The farther we penetrated to the north, the clearer the visibility became and there was hardly a breath of wind. The sea was perfectly calm, but so far as the eye could see there was ice and nothing else. We took a few photographs, particularly some of the first icebergs which we encountered, so that we might have a permanent reminder of this very impressive sight. Finally we became so accustomed to the ice regions that we came down very low.

After a flight of five hours we reached Scoresby Sound, the largest bay of the Greenland coast on the east. We saw nothing but floating ice and icebergs, and became a little anxious because, although the settlement was clearly marked on my map, we could not discover its location. After circling about along

the coast and the bay, we finally discovered the little houses of the settlement dotted here and there. Our next trouble was to find a space on the water which was sufficiently free from ice to permit our landing. The colour of the water was dark blue and wonderfully clear, the surface was smooth and the mountains were beautifully reflected in it. When we struck the surface of the water on landing, we all had a feeling of great relief after our long flight over the ice.

We soon found that life in Scoresby Sound was not quite so lonely as we had imagined. An American millionairess, who was deeply interested in Arctic exploration, had chartered a little steamer in Norway and had announced her approach by wireless. Every year she collects a few friends and explores these regions. This year she selected the sounds of East Greenland and shortly after breakfast the ship arrived. This was a most exciting day for so remote a little settlement—seaplane from Germany and a strange ship from Norway. You must realize what this means for the people of Scoresby Sound, who only see a steamer once every year for two or three days.



FLOATING ICE.

As the expedition penetrated into Scoresby Sound, icebergs and floating ice became so numerous that it was hardly possible to see any water.

During the afternoon we accompanied the district Governor on a boat trip to a settlement of Eskimos, who were as yet untouched by civilization. This proved of great interest to me, in so far as it gave me some ideas of a possible landing in a seaplane between floating ice and icebergs. The ice seen from the air often looks like a solid mass, while in reality it has sufficient wide channels which would make it possible for a seaplane to come down and paddle along inside these gaps. A close view reveals the fact that the floating ice is not as dangerous as it looks from the air. On the following day we decided to risk a start from Scoresby Sound straight across the inland ice to Godthaab. Our difficulty was that we had to carry petrol to last us for ten hours, fly along the fjords for at least one and a half hours, after which we had to obtain a height of about six thousand five hundred feet. If, as planned, we had flown over Angmagsalik we would have required petrol for only five hours to cross the inland ice, which would have made the plane considerably lighter and the flight much easier.

We flew over Cape Hopes where our Eskimo friends of the day before and the Boyd Expedition waved us a final farewell. We then passed over the peninsula called Jamesland, which is free of ice and the only point on the east coast of Greenland where the musk ox can exist. We soon spotted a herd of them; on our approach they became alarmed and in their fright formed a ring round a big bull. From above the formation looked like a star; they stood perfectly still until we had passed over them, after which they took to flight.

The deeper we penetrated into the sound the more unpleasant it appeared to us below. Soon we could hardly see any water, due to icebergs and floating ice. But all this provided good opportunity for taking photographs. When we reached the end of the sound we became a little anxious. The mountains were already about eight thousand feet high, sudden bad squalls were buffeting our plane considerably and we encountered a strong down wind, so that our boat with full throttle did not obtain the necessary height to permit a crossing of the inland ice. We therefore made our way with much difficulty over a few lower glaciers, and although we hoped to see the inland ice at any moment, we were time and again confronted with new and still higher mountains which we either had to surmount or encircle. It took us an hour to clear these promontories which were not indicated on our map; even when we had cleared these obstacles and had succeeded in reaching the inland ice, the latter rose so rapidly that we had to continue to fly under full power. We began to climb gradually to a height of ten thousand feet, the highest point which the inland ice reaches. I felt confident that an emergency landing could have been effected without accident as the inland ice is perfectly flat; but in spite of our polar equipment, it would have been extremely difficult for us to get back to Scoresby Sound or Angmagsalik, the only inhabited parts along the three thousand kilometre east coast.

The farther we flew the more we realized that we could only reach Godthaab with our last drop of petrol as our climbing efforts had used up too much

of our fuel. I therefore decided to make for a little place called Sukkertoppen, which is about an hour's flight from Godthaab. Luckily we were able to make contact with the radio station at Godthaab and informed them of our change of plan. They replied that the harbour of Sukkertoppen was well situated and sheltered and that they could send us a supply of petrol from Godthaab in a day. We finally came to a glacier which sloped down to the mouth of a fjord. From the map it was clear that this was the Eternal Fjord. The next day we were ready to continue our flight to Godthaab. On arrival there the representatives of the colony approached us to deliver a welcoming address which we did not understand.

Continuing our journey, we eventually found ourselves over the Hudson Strait and were approaching an island which was indicated on the map as the Akpaktok Island. We eventually came to the east coast of North Labrador. The coast of North Labrador did not look as dangerous as I had expected; there were a good many bays and some of them even had sandy beaches. Now and then we saw the tents of an Eskimo settlement, and altogether everything appeared much more convenient for an emergency landing. After a short while we found ourselves over the wooded regions, and for the first time in four weeks we saw trees. For the next three hours we flew along over endless tree-tops until we finally saw the first railroad lines. They ran as straight as a die from east to west and we were fast approaching civilization. We saw a second railroad line and a train which we followed and soon came to our destination, Long Lake.

GODTHAAB FJORD.
When the plane eventually reached Godthaab the representatives of the Colony greeted the party with an impressive address of welcome.

We lost little time to start for our final destination. We passed over Long Lake, which seemed to be without an end. When we cleared it we encountered high mountains. They looked magnificent, but were detrimental to our petrol supply as we had to climb higher to clear them. After a while we arrived at Lake Superior and the atmosphere became more and more misty. We encountered a fog, but having received a radio report that conditions over the land which we had to cross to reach Lake Michigan were good, we climbed over the fog and continued our flight cheerfully.

Every radio station in this vicinity was in communication with us giving us weather reports and directions. We passed over Milwaukee and soon after that Great Lakes. We had been asked to come right up to Chicago so that the people could see the landing and our plane. We had just sufficient petrol, and at last we were circling over the skyscrapers of this gigantic city. In due course we had to prepare for our departure via Cleveland to New York, where our flight ended.

The main activity in Greenland was obtaining meteorological information for the flight. For this a knowledge of local weather was indispensable. Generally speaking, two weather types may be singled out which give the weather on the west coast of Greenland its distinctive character. Namely—the area of high pressue due to continental thermal conditions, and the low pressure over the Davis Strait which in most cases is only in the form of a weak secondary depression or tongue of the cyclones passing over southwards from Cape Farewell. The direct influence of the areas of low pressure passing at the south of Greenland does not generally extend into the latitude north of Godthaab; it is rather the tongues which, in conjunction with areas of low pressure, pass by the very much more northerly course via North Canada to Baffin Land, and there generally fill up. About 200 kilometres south of Godthaab there is the neutral zone which represents the boundary between the disturbances of the far north and the Atlantic. Narrow fjords are protected from fog.

In many cases the fog does not recede more than 500 metres to one kilometre from the coast, and remains in the same position all day. In such circumstances, in the face of the threatened fog, a forecast (whether influx of fog or not) is extremely difficult. All this applies mainly to the coast only; within the fjords there is no danger of sea-fog suddenly appearing, which is a great advantage for air ports within the fjords. For this reason, Godthaab could hardly

(*Concluded on page* 400).

New Light on Edmund Burke.

By H. V. F. Somerset, M.A.

Edmund Burke was famous as an orator and thinker, but the reason why he was denied high political office has been somewhat obscure. Some hitherto unpublished correspondence, to which the author has had access, throws interesting new light on the life of Burke, and helps to explain the comparative failure of his public career.

It has always been a much discussed question why Burke was not more of a worldly success and why he never held high office. Two reasons are given for this failure: first, the comparative obscurity of his birth, and second, his somewhat "difficult" temper. Continually some fresh publication comes to shed new light upon Burke—such volumes as the Farington Diary, the Granville Correspondence, the Letters of George III, and so on. In the present article, quotations are made from some hitherto unpublished material in the possession of Sir Harry Verney, Bart., of Claydon, Buckinghamshire. Some earlier letters have, of course, already been published.*

The Verney Letters.

Lord Verney was the first man to give Burke a seat in Parliament, when he enabled him to secure the borough of Wendover, Bucks, in 1766. It is from the papers left by Lord Verney, giving us glimpses into the transactions carried on between him and Burke's "kinsman," William Burke, that we can gather some idea of the atmosphere which must have surrounded both Burke himself and William, whose fortunes he was always seeking to push. For Burke was as "pushful" for others, as he was retiring in anything that concerned himself, and from the speculations of his kinsman he probably also suffered.

What was the exact nature of those speculations, in the West Indies or elsewhere, into which William Burke led Lord Verney, it is not necessary to enquire. Suffice it to say that Margaret, Lady Verney tells us that the Burkes' unpaid debts to Lord Verney amounted in 1769 to some £25,000; while in 1784 "in a schedule of sums due to him are the entries 'Rt. Hon. Ed. Burke £11,000, Wm. Burke, Esq., £20,500, do. No security except honour £40,000.'" And these sums must considerably have hastened on that peer's final bankruptcy. But the story of the immense losses which William Burke caused Lord Verney, is already pretty well known. Is it, however, generally realized that Lord Verney at one time was contemplating legal proceedings against the great Edmund himself? Yet it is clear that this was so, if we peruse the letters and papers that passed between Lord Verney and his legal, and other, advisors.

**The Verney Letters.* (Benn. 1930.)

It is true that the Bill in Chancery filed against Burke by Lord Verney in 1783 has been printed, together with Burke's sworn answer, in the late Sir Charles Dilke's "Papers of a Critic" (pp. 367-370.) and serious charges are levelled against Burke there, But very little notice has been taken of it. Perhaps too little. Although we agree with Burke's recent biographer, Mr. Bertram Newman, that Dilke would seem to have insufficient grounds for all of his suspicions of Burke's probity and disinterestedness, we consider that the evidence there supplied by him is still sufficient, if not to inculpate Burke, to explain the suspicions and the scandal that were current concerning him in the journals, and to some extent in the correspondence of the time. This evidence, like that which the papers at Claydon supply, therefore, has a considerable bearing upon the history of his character and career.

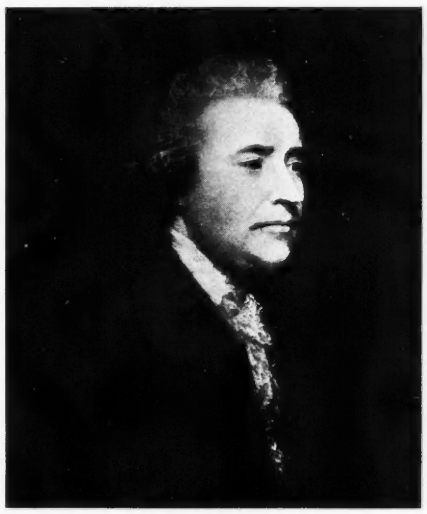
In one of the papers at Claydon, which gives a sort of schedule of Lord Verney's debtors, we read: "Edmd. Burke Esq.—See the state of this case already sent (not extant). There are several of Mr. Burke's notes of hand in Curzon Street, which ought to have been taken notice of in the bill filed against him, and if the bill can now be emended the same shod. be charged therein." In another we find the following, with the words "Chancery Proceedings" crossed out: "From Schedule of Papers at Mr. Harman's.

Earl of V
agt.
Edmd. Burke Esq. } Chancery Proceedings, Letters, etc."

Burke's Speculations.

What is the meaning of these threatened proceedings? Evidently Burke had been borrowing extensively from Lord Verney for the purchase of his estate at Beaconsfield, and perhaps for other purposes; just as his "cousin" William Burke had been playing a desperate hand in speculations in the Indies. Moreover, Burke apparently not only borrowed money to purchase his estate of Gregory's and then mortgaged the estate back for £10,000—as we learn from "The Diary of Lord Colchester" (1796)—but also proceeded to borrow more money on the security of the estate. For in another paper in Sir Harry

Verney's possession we read : " Mr. Farrer of Chancery Lane was solicitor to Sir Charles Saunders, who lent Mr. Burke £4,000 on Lord Verney's consenting that the sum should be secured upon the Gregories estate prior to his £6,000—and it's presumed Mr. F. knows all the circumstances relative thereto." Then follows in different writing : " No proceedings to be taken against Mr. E. B. till Lord V. has ratified a sale of Wendover and Abthorpe—reply this done then if council advise proceedings against E. B. as probably for success, to proceed immediately therein—otherwise not to proceed."



EDMUND BURKE.
From the portrait by Reynolds recently presented to the National Gallery of Ireland.

As far as we are able to conjecture, this fragment forms part of a document dated April 4th, 1788 ; and if this be so, it is not surprising that Burke was so eager and reckless in the Regency debates in the spring of 1788, when Pitt was trying to prevent the Whigs from hoisting themselves into power, on the shoulders of the Prince of Wales. Mr. Bertram Newman, indeed, refers to his " only too well grounded anxiety for the emoluments of office " ; and discusses and illustrates his extreme violence at this time. Though on the whole Mr. Newman considers, as we have said, that Burke's continued financial embarrassments did not really do much harm to his political career.

However that may be, the bad character and shady doings of William Burke cannot surely have done the great statesman any good in the general estimation. And William Burke at one time seems to have been almost flying from justice to the shelter of Edmund's roof. In December, 1787, for instance, we find one of Lord Verney's correspondents, Mr. Heslop, writing : " Upon the report that he was returned to England and at Mr. F. Burke's I employed a friend of the next parish to learn the truth. But after all enquiries I cannot find that he is yet returned."

It is interesting to note that there are some letters at Claydon from no less a person than the poet Samuel Rogers which refer rather curiously to the subject of the Burkes. For instance, writing on September 11th, 1783, Rogers says : " I see you have begun upon the Burkes. God grant successful issue of your suit(s) if founded in justice, as, I doubt not, they are. You will not I hope suffer yourself to be deluded into a compromise by the lure of any post under Government they may pretend to get you one day and tear from you the next, when you have renounced all claim upon them in consideration of such place. As to myself I most devoutly pray that the overruling Providence of Heaven may enable you to bring such monsters to justice and shame ; and shortly to triumph over every difficulty and distress which of late you have had to struggle with from the knavery and duplicity of mankind." Such sentences as these certainly give some colour to the statement of Sir Charles Dilke that " all the correspondence of the period refers to the Burkes in a singular manner."

But however false or true the stories which Sir Charles Dilke tells us were then circulated, at least they were in the air. And our thoughts, as we examine the papers connected with the Burkes at Claydon, rather naturally turn back to those old tales, and to some of those observations that were made by Dilke in the middle of the last century. What is the resultant picture ? It is that of a great man, of a great genius in fact, suffering very cruelly from the crushing weight of circumstances, but suffering also very considerably from his intimate connexion with a group of persons who were, it appears, universally mistrusted and disliked. For on all sides, as Dilke says, we find evidence that many of Burke's relatives, followers, and associates were not such as his better friends could easily bring themselves to tolerate.

One would like to know what Goldsmith really thought of the Burkes. But we shall never know it. For, according to an unpublished letter at Chatsworth. he was prevailed upon to destroy the characters of the Burkes that he had written in his " Retaliation," and to replace them by other passages much less severe. Among the various reasons given to explain Burke's lack of political success, then,—such as his Irish birth, his lack of aristocratic connexions, his difficult temperament—these two, his financial instability, and the set by which he was surrounded, must have been among the principal.

A Year of Progress in Television.

This year has been one of outstanding progress in television. The pioneer British system invented by Mr. J. L. Baird can be said to have come into its own with its adoption by the B.B.C. The regular transmissions from Broadcasting House have greatly widened the public interest in this new and growing science.

LAST February, Mr. J. L. Baird, the inventor, predicted that the present year would see television come into general use; he announced that his company were developing a receiving apparatus which could show "television images upon a screen, so that they can be seen by a roomful of people at the same time." The new apparatus, he hoped, would be available before the end of the year. Actually it was shown to the Press in July, when the remarkable advance resulting from screen projection was at once appreciated. There has been some delay in marketing the model but a further announcement is expected shortly.

In March came the news that the B.B.C. were hoping to extend regular facilities to television. Hitherto the broadcasting authorities had maintained a very cautious attitude, believing that the public for this latest branch of radio was too small, compared with the millions of listeners, to justify attention in programme hours. The advantage of the B.B.C.'s co-operation at the transmitting end was foreshadowed in our contemporary, *Television*, by Mr. T. Thorne Baker, who emphasized the immense importance of studio technique. "It can," he wrote, "accomplish so much for the improvement of existing television, that all physical calculations on the basis of the number of lines or areas to the square unit of surface can be entirely upset, and the eye can be made to see modelling and definition that by theory are impossible.

"It is very important that due emphasis be laid on this point. Whilst amateurs continue to build up the television set and increase its potentialities, let studio experts with the experience of modern picture-making concentrate on improving the transmission. Television, like the 'pictures,' and like wireless broadcasting, is one of those peculiar mixtures of art and science, of stage management and academic engineering, that demands a true versatility of mind and generous blending of talent if we are to make quick progress." This view has been amply justified by the new B.B.C. transmissions.

The possibilities of television by ultra-short waves were demonstrated publicly for the first time in May, when transmissions from the Baird studios in Long Acre were picked up on the roof of Selfridge's in Oxford Street. The demonstration not only represented an important development at the transmitting end, but an entirely new experimental receiver was also employed, in which the image was shown on a screen instead of in a lens. The size of the image was considerably larger, so that a number of people were able to see it simultaneously. A wave-length of 6.1 metres was used.

It was explained at the demonstration that the ultra-short waves—those below a length of 10 metres—formed an alternative method of television broadcasting which did not in any way interfere with the B.B.C. service. Advantage had been taken of this to erect an ultra-short wave station at Long Acre in order that transmissions might eventually be made at any hour of the day. The ultra-short waves had the additional advantages that they allowed television pictures of much finer detail to be transmitted, and they provided a reliable local service free from fading and atmospheric disturbances. The present transmitter had a radius of five to ten miles, but in due course it was hoped, with the collaboration of the B.B.C., to extend the system to cover a wide service area. Similar research was undertaken

IN THE TELEVISION STUDIO.

Vanda and Vladimir, the dancers photographed during a television transmission at Broadcasting House. Part of the apparatus is seen on the right.

this year in Germany by the Post Office, which demonstrated an ultra-short wave transmitter at the Berlin Radio Show. The broadcasting of films on 7 metres has proved successful.

Popular interest was roused in June by the televising of the Derby, which was watched on the screen of a London cinema theatre by over 2,000 people. The signals were relayed over the public telephone cables under difficult conditions, and although the images were very crude, the audience was able to see the horses flash across the screen as they passed the winning post at Epsom fourteen miles away. An attempt to televise the race had been made in the previous year but this was the first time that the ambitious experiment had been made of projecting the images on a theatre screen.

MR. BAIRD WITH THE LATEST "TELEVISOR."
In Mr. Baird's latest model the image is thrown upon a screen 4 in. high by 9 in. wide instead of being seen in a lens, as previously. It can be worked without special knowledge of wireless.

The Baird daylight television apparatus, described at the time in *Discovery*, was housed in a trailer caravan at Epsom near the winning-post. Inside was a large drum with thirty mirrors, revolved at a speed of 750 revolutions per minute, which split up the whole scene into thirty strips. A succession of images thrown by a lens on to the drum was made to move over three apertures, which admitted the different degrees of light and shade to three photo-electric cells. In this way the scene was split up into three adjacent zones and the separate signals passed to amplifiers, from whence they passed by telephone lines to the control room at Long Acre. From here they were relayed to the stage at the Metropole Cinema, and after being further amplified were passed to the receiver.

The opinions of the Press representatives who attended the theatre varied considerably but agreed that the performance marked a big step forward for television. The *Morning Post* said that "the general level of reproduction was of a standard which a few years ago could have been achieved only under laboratory conditions." *The Times* reported that "the bunch of horses which included the winner was clearly seen as it flashed past the television camera."

In July the first particulars of the Marconi Co.'s "news" transmitting apparatus appeared. This company has always specialized in the commercial applications of radio and its engineers therefore approached television from a different angle from that of broadcasting pictures. One point that appealed to them was, that if television is to be employed for commercial purposes, it will not always be able to claim a special frequency channel, and the use of the normal commercial wavelengths and frequency bands would have to be considered. Wavelengths, for instance, at present in use in telephony may be the only ones available for a particular television service, and the frequency band provided for the telephone channel may have to be accepted for the purpose of television.

The "news" transmitter requires only a narrow frequency band and can be used, with certain limitations, on any wavelength up to 3,000 metres without creating more disturbances in other than good quality broadcasting. The Marconi apparatus and other television equipment was shown to the members of the British Association during the annual meeting at York, where it attracted considerable interest.

In July attention was drawn to the progress of television abroad by the announcement that sight and sound had been successfully broadcast on one wave in America. The new system was inaugurated on the first anniversary of the Columbia Broadcasting Company's television station, when an orchestra playing on the roof garden of the Hotel St. Moritz, New York, was directed by a conductor in the studio a quarter of a mile away. Vision receivers set up in front of the musicians enabled them to follow the baton of their director as he faced the transmitter.

It is still difficult to estimate the value of the new "one wave" method, but it has been proved practical after extensive tests under field conditions. At the demonstration it was announced that there are more

than 9,000 television sets in use in New York City alone, while transmissions sent out from the Columbia Station have been received at distances up to 2,000 miles. Already there are thirty stations broadcasting television in America, where there is no State control of broadcasting.

To return to England, the biggest event of the year was, of course, the beginning of regular television programmes from Broadcasting House. The installation of the apparatus took longer than was expected and there was general disappointment when the date originally announced for the first night had to be deferred. However, on August 22nd a successful programme was transmitted from the television studio in the new B.B.C. headquarters.

From the outset it was obvious that the facilities available in Broadcasting House would be of the greatest assistance to the development of television, both from a theatrical and technical standpoint. The first night opened modestly with singing and dancing, but within a few weeks a sea-lion was included in the programme. This was naturally "featured" in every newspaper in the country and attracted great attention to television. A few nights later Joe Young gave a demonstration of Yo-Yo; conjurers, cartoonists and jugglers followed in quick succession in the programmes. The serious intentions of the B.B.C. toward television were shown when Mr. J. A. Mollison was televised during the broadcast which he gave after his latest Atlantic flight. He was accompanied by Miss Amy Johnson, who thus had the distinction with her husband of being a pioneer in another great development of modern communication.

The first B.B.C. television programme coincided with the National Radio Exhibition at Olympia. More than 170,000 people visited "Radiolympia" and this record attendance was an appropriate tribute to the progress of British broadcasting in the ten years since the B.B.C. was formed in 1922. Another sign of the times was the fact that the gold medal at the International Exhibition of Inventions was awarded for a new television apparatus. Many inventors are working quietly on the problems of television, and not only private individuals but some of the biggest radio companies are engaged in research.

Across the Ice-cap

(*Concluded from page* 395.)

be used as a base for a regular air service. The other stations on the central and south-west coast suffer more or less from the same disadvantage. For this reason, small places inside the fjords are preferable. The ice conditions on the west coast of Greenland offer no direct obstacle to flying during the summer (apart from the fogs). The fjords and also the coast are free from ice almost all through the year, so that the motor-boat service along the coast is hardly ever interrupted. With strong south-west winds, however, it sometimes happens that quantities of drift ice are driven into the fjords and some of the ports, for instance Julianehaab; these are either filled or blocked with ice. This happens much more rarely on the coast near Godthaab, as there the quantities of drift ice have already considerably decreased. The Godthaab district may be called an ice-free zone as the winter pack ice begins 400 kilometres north of Godthaab, in the Holsteinborg district and north thereof.

In the Fjords.

When disturbances approach the coast, the wind sometimes freshens up very suddenly. Owing to the high pressure gradient produced on the coast (as the area of high pressure over Greenland maintains its position) the temporary violent freshening up of the wind over the fjords is very marked. Frequently, far in the fjords strong down gusts have been observed which have been indicated by the cloud formation, and these gusts are such as would certainly be very dangerous for aeroplanes in the fjords.

An important question is, which route should be chosen for a flight from Iceland to Greenland in order to enjoy the most favourable meteorological conditions? The route via Scoresby Sound, which was selected mainly from scientific considerations for this year's Greenland flight, is too complicated from the meteorological point of view. The dangerous stretch from Scoresby Sound over the inland ice to the west coast, is too long. There are really only two routes to be compared, namely, Reykjavik-Angmagsalik, over the inland ice to the west coast, and Reykjavik-Cape Farewell, to the west coast. Further, it must be decided if the port of destination should be more to the south, in the Julianehaab district, or further to the north towards Godthaab. In accordance with what has already been said, preference must be given to a port in the vicinity of Cape Farewell. The stretch of inland ice can then be avoided, and not only that, it very often happens that the atmospheric conditions on the east coast (Angmagsalik) and on the west coast (Godthaab) have exactly opposite weather conditions—either good weather in one and bad in the other, or *vice versa*. This difficulty will not be experienced in the same measure on the route round Cape Farewell, as there we have an area of similar atmospheric phases.

Research on Animal Health in Australia

By Our Dominion Correspondent.

In a country where sheep and cattle raising are the chief industries, research on animal health is of the first importance. The author deals with the latest work at the various research stations in Australia, which includes the discovery of a vaccine against "black disease" in sheep.

NEARLY 98 per cent of Australia's exports are agricultural, and of this proportion about two-thirds consist of animal foodstuffs and substances. The Commonwealth, whose wool-clip realizes an average value of over £42,000,000 yearly, is the world's leading wool-growing country, with less than one-sixth of the world's total of sheep. She is responsible for one-quarter of the annual supply, including one-half of the world production of fine merino wool. New South Wales, Victoria, South Queensland and South Australia are the principal sheep-growing areas.

In all the States cattle-raising is carried on more or less extensively, the main object in certain districts being the production of stock for slaughtering purposes, and in others the raising of dairy herds. The impetus which the growing export of Australian butter gave to the dairy industry led to a considerable increase in the numbers and quality of dairy herds, particularly in Victoria, New South Wales and South Queensland, since this portion of the Australian temperate zone is naturally adapted to the industry. On the other hand, by far the finest specimens of beef-producing cattle are those raised in the tropical areas of North Queensland, the Northern Territory and North-west Australia.

In all phases of the sheep and cattle raising industries, research on animal health and nutrition has played an important part. Since it was set up in 1926 the Commonwealth Council for Scientific and Industrial Research has established a network of investigations dealing with various problems that have arisen in plant husbandry, animal health and nutrition, entomology, soil science and forest products.

Growing Research.

The Animal Health division, founded in 1929-30 following the visit to Australia of Sir Andrew Theiler, the South African expert, is directed by Dr. J. A. Gilruth, of Melbourne, with Professor F. E. Crew and Mr. Eldon Moore as his associates. The division has kept in close touch with the Animal Breeding Research Department at Edinburgh University, one of the eight Imperial agricultural research bureaux set up in 1927 to act as clearing houses for the interchange of research information throughout the Empire. Animal health investigations are carried on in Sydney, at the University Department of Veterinary Science, and at the recently opened McMaster Laboratory, where demonstrations are given by Dr. I. Clunies Ross, the council's parasitologist, in pathology, bacteriology, and parasitology. In Melbourne, at the Veterinary Research Institute, under Professor H. A. Woodruff and Dr. A. W. Turner; in South Australia, at the State Laboratory of Bacteriology and Pathology, Adelaide, under Dr. L. Bull and Mr. C. G. Dickinson; and at Perth, West Australia, by arrangement with the State Department of Agriculture.

Disease in Sheep.

The outstanding achievement of the past year was the research on the black disease of sheep conducted by Dr. Turner, who showed that the malady is caused through infection following injury to the liver by the young fluke; he has succeeded in preparing a vaccine which exerts a valuable protective influence. The economic value of this work may be measured from the fact that annual losses from black disease in Australia amount to over £1,000,000. The result will be a saving of £100,000 in Tasmania alone, with corresponding economies in the other States affected. Black disease has been found to exist in Germany, where it is known as *bradsot*, and investigations in Britain suggest that it occurs, unrecognized as such, in other parts of the world. Dr. Turner's achievement is therefore of world-wide significance.

In West Australia, Mr. H. W. Bennetts, veterinary pathologist to the State Department of Agriculture, has discovered that the braxy-like disease of sheep (infectious entero-toxaemia) which occurs in this territory, is a distinct organism of the same group as in the European disease (*bacillus Welchii*). It is believed that the malady is more prevalent in eastern Australian States than has hitherto been suspected, and that it may have caused the death of numbers of animals which have supposedly died from black disease. Mr. Bennetts has evolved a vaccine to be used against it, and a large number of sheep have been tested. From a flock of 924 animals deaths were reduced from 4.6 per cent to .2 per cent. About 10,000 sheep have since been vaccinated.

Mr. Bennetts has also diagnosed an obscure disease

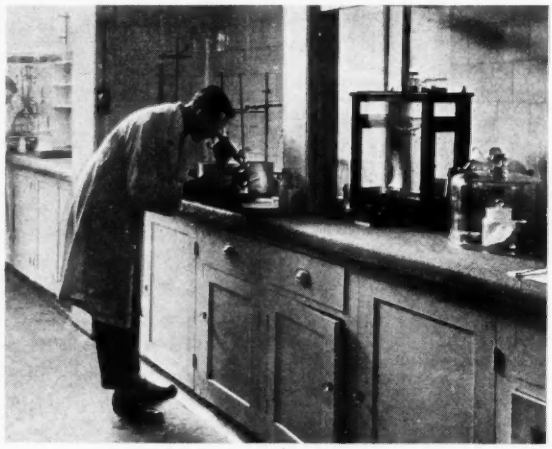
affecting young sheep in the Gin Gin and Moora districts of West Australia. It is confined to a limited area and can be prevented by transferring healthy pregnant ewes for a short period annually to other pastures. Its cause is associated with malnutrition, and research experiments with small flocks are being carried along these lines. Another veterinary official, Mr. J. F. Filmer, has discovered that West Australian sheep may also be subject to the Denmark cattle disease, and a special farm has been devoted to the investigation of this malady.

The study of parasites, initiated in 1930 by Dr. Ross, has been successfully continued by Dr. Kauzal, of Sydney University, and others. Work in connexion with the control of kidney worm in pigs was completed last year, and as a result of the study of the life cycle of the parsite, methods of its control and eradication have become practicable. These, when adopted, should result in a marked decrease in the incidence of the parasite throughout east Australia, particularly in New South Wales and Queensland, the areas most affected. Dr. Kauzal has also concluded an investigation of the life cycle and the pathogenic importance of lung worm in sheep, and has tested the effect of various drugs in licks or drinking water against stomach and intestinal worms. Field trials have been commenced on properties in central Queensland, News South Wales and Tasmania regarding certain aspects of the infestation of sheep by these parasites.

A Serious Menace.

The problem of *caseous lymphaderitis* constitutes a serious menace to the whole Australian export trade in frozen lamb and mutton, as the British health authorities have prohibited the importation of mutton with glands affected by this disease. As the percentage of animals affected in Australia is high, the Council attaches great importance to a systematic attack on the problem, and Dr. J. A. Gilruth has been appointed to co-ordinate the various researches. The primary object of the attack is to ascertain the means by which the disease is spread, and then to devise preventative methods. At the Sydney Veterinary Institute an investigation has been made of the casual organism, its toxin and diagnostic tests, and the elaboration of a diagnostic reagent. Dr. L. Bull and Mr. C. G. Dickinson are at work on the discovery of a reliable vaccine at Adelaide Hospital Laboratory, and field experiments are being carried out on properties in Victoria and at an experimental farm near Melbourne.

Other laboratory investigations at Adelaide include research into the incidence of *haematuria* (red-water)



A RESEARCH LABORATORY AT VICTORIA.
In all phases of the Australian sheep and cattle raising industries, research on the health of the animals is playing a growing part.

in cattle, and field conditions are being studied in the Mount Gambia district of South Australia, where this disease is probably more prevalent than in any other part of the Commonwealth. Great difficulty has been found in detecting the cause of the malady; it was formerly thought to be due to a deficiency of manganese in soils or plants, but this has now been discounted. At present experiments are being worked out on the effect of various mineral supplements to the diet of animals, and these may shortly lead to a solution of the problem.

Research on tuberculosis and pleuro-pneumonia in cattle has been carried out by Professor Woodruff and Mr. T. S. Gregor in Melbourne, who first found a test for the diagnosis of the disease for use under field conditions. This has been found valuable for testing animals before allowing them to pass from an infected locality to a clean herd or area. The investigators later discovered that the Bacillus Calmette-Guerin vaccine is innocuous and confers some degree of resistance against infection with virulent tubercle bacilli. Herds known to be highly infected have been chosen and the majority of calves are vaccinated shortly after birth and vaccinated annually. Queensland and North Australia are responsible for the whole of the export of Australian beef, and for many cattle which are fattened in southern districts. In response to a demand by northern pastoralists for research work on conditions unfavourable to their occupation, the Council has organized an ambitious attack on cattle diseases. Operations commenced early this year, and liberal subsidies have been made by the Empire Marketing

Board, by local contributors, and by the Queensland Government, which has also placed its stock experimental station at Townsville at the Council's disposal. The Australian Pastoral Research Trust and the Empire Marketing Board have co-operated with the Council in a new programme of investigation regarding the health of sheep, each contributing funds. The scope of the work in animal health has thus been greatly extended, particularly regarding field work in Victoria, vaccinations for black disease, parasitological experiments on a large scale in Queensland, New South Wales and Tasmania, foot rot in Victoria, and pregnancy disease of ewes and pulpy kidney of lambs in Tasmania.

The Division of Animal Nutrition, founded in 1927 under the direction of the late Professor T. Brailsford to carry on an extensive investigation into problems associated with the nutrition of stock, is now conducted by Sir Charles Martin, formerly director of the Lister Institute of Preventive Medicine, London, with Dr. J. B. Orr as his assistant. For many years to come research in Australia will be confined to the study of sheep. The ultimate aim is to obtain information whereby sheep reared in different localities and climates of Australia may be so fed as to yield the best economic results. Confirmatory evidence has been obtained as the result of field trials in Queensland concerning the value of certain proteins as supplementary feed to sheep. It is now possible to obtain an increase of over 30 per cent in the weight of the fleece at a relatively small additional cost. A wide application of these results will effect a material decrease in the cost of wool production.

Studying Pastures.

Phosphorus deficiency is a serious matter in many pastoral areas in Australia. Considerable progress has, however, been made in determining the form of phosphorus with which the deficiency can be most economically cured. The division started last year to determine the best and more economical methods of supplementing the feeding of sheep during droughts, and of combating evils attendant upon insufficiency of phosphorus in pastures. A new laboratory has been opened in Adelaide for this purpose.

As Sir John Russell showed in a recent article in *Discovery*, the nature of pastures may be altered profoundly by the use of fertilizers, the introduction of new pastoral plants, and by varying the character of pasture management. Since practically the whole of the Commonwealth's sheep and cattle is maintained on indigenous pastures, the value of these investigations is obvious.

New Studies of Meteorology.

Some recent meteorological investigations were described by Dr. G. C. Simpson, F.R.S., director of the Meteorological Office, in a recent lecture to the Institute of Physics. When large and violent explosions occurred, he said, it was noticed that the sound was loudest near the origin and then decreased, as one would expect, until at a certain distance, about sixty miles, it could no longer be heard. But the surprising observation was made that at still greater distances, more than 120 miles, the sound was again audible.

Much work has been done to try to find an explanation of this curious effect. In this country Dr. Whipple of Kew Observatory organized an investigation in which university students recorded with delicate instruments the sounds made when large guns were fired in Shoeburyness near the mouth of the Thames. The result of this work has shown that the old idea that the upper atmosphere—the stratosphere—is cold throughout can no longer be held. The stratosphere is cold up to a height of about 25 miles and then it becomes warm again, and at great heights becomes even warmer than at the surface.

The Upper Atmosphere.

The theory of optics has been used very much in meteorology especially to determine whether clouds are composed of water or ice, but recently spectroscopy has been used by Dr. Dobson of Oxford to investigate the amount of ozone present in the upper atmosphere. He finds that, while there is practically no ozone lower than 30 miles above the surface, at greater heights there is a relatively large quantity, and it is the presence of this ozone which makes the upper atmosphere warm.

Dr. Simpson described some of his own work on the balance of incoming and outgoing radiation. Heat reaches the earth as short wave radiation from the sun and leaves again as long wave radiation from the upper atmosphere. The incoming radiation is much greater in equatorial than in polar regions, thus accounting for the difference of temperature between the equator and the poles. Calculations, however, show that the outgoing radiation is practically the same from all parts of the earth and the poles send as much radiation into outer space as do the equatorial regions. As the polar regions send out much more heat than they receive from the sun, the loss has to be made up by transfer of heat from low to high latitudes. It is the transfer of this heat which is the driving force of the winds.

Book Reviews.

Problems of Relative Growth. By JULIAN S. HUXLEY. (Methuen. 12*s*. 6*d*.).

The title of this book is a fascinating one, for "problems of relative growth" really constitute the fundamental question of the science of development or embryology. The transformation of the spherical egg into all the varied forms of animals is effected by the unequal growth of different parts, and when a brilliant scientific man like Professor Huxley announces a book with this title, we eagerly welcome it in the hope that his researches have enabled him to contribute something to the solution of this problem, which in our opinion is *the* primary problem of all biology. If, as we think, Professor Huxley has not been able to penetrate very far into the cloud of mystery which veils the nature of growth, at any rate there are contained in the book many new and interesting facts which will act as stimulants to further research; and this is perhaps the most valuable service that such a book can render in the present state of our knowledge.

The distinctive feature of the author's researches is that he has *measured* the relative growth of different organs at successive stages of development, and has endeavoured to express his results in mathematical form. He pleads that unless we do this we can only have vague ideas as to the nature of what is going on. This is only partly true; undoubtedly without measurement we can have only guesses, but whether equations and mathematical symbols really help us is another matter. Such formulae inevitably suggest that we have successfully penetrated to the fundamental laws that govern biological phenomena, laws which operate with the precision of physical and chemical laws and which are the expression of the unalterable nature of the constituent atoms and molecules. Now all such attempts to formulate simple physical explanations of living processes have so far proved disastrous failures. The "laws" appear at first sight to fit a few cases; further examination shows that they do not fit exactly, and that when the number of cases is extended these laws require the assumption of other laws which modify the first ones, and so on *ad infinitum*, until the final theory bears a strong resemblance to an unwieldy house of cards. For an example we may recall the woeful collapse of the assumed simple laws of Mendel. The "unit-factor" or "gene" which was supposed to afford a simple solution of the phenomena of variation and inheritance has had to undergo continuous modification until the latest exponents of Mendelism talk of a "variable" gene—an expression which is a contradiction in terms, and as an explanation may rank with the theological phrase "the sinfulness of sin."

Professor Huxley has given special consideration to the growth of what are known as secondary sexual organs—which may be briefly described as exaggerated growths of certain organs in one sex associated with the onset of sexual ripeness—such as the enormous size of one claw in certain male crabs or of the mandibles in some male insects. In such cases he says that the growth of the enlarged organ bears a relation to the growth of the rest of the body, which is expressed by the equation $y=bx^k$, where y is the rate of growth of the organ and x the rate of growth of the rest of the body. But the value of the all-important index k does not remain constant—it varies at different periods and may even sink below unity. Put into plain English, this means that successive stages in development are characterized by the outburst of new powers of growth and the waning of old ones. But this is a commonplace to the comparative embryologist, and Professor Huxley's idea that these growth-relations will enable him to explain away the "recapitulative" or "memory" factor in development is in our opinion a complete delusion. The first thing to determine is whether in any life-history there is unequivocal evidence of the presence of this factor—if it really exists in any life-history; if there really is a repetition of the past condition of the race in one case we may be pretty certain that it is present in more or less veiled form in all, since all life-histories commence with the simple unicellular egg. Many such cases occur to the mind, but one or two may be mentioned which may be termed decisive. Thus the typical Ctenophore or "Comb-bearer" is a beautiful pelagic animal of globular shape and glass-like transparence, with a sense organ at one pole and the mouth at the other. Between the poles stretch glittering meridians of vibratile plates by means of which the animal moves.

Now there has been found by Mortensen an extraordinary beast which he has called Tjallfiella, which looks like a sponge or a compound ascidian and appears to be fixed to the substratum. Yet the young of this animal are typical globular ctenophores. Then, again, there is an animal called Coeloplana which looks an ordinary flat-worm and crawls over the bottom; yet in this case also it begins life as a globular ctenophore. What equations of "growth-relations" can explain cases like this? What other account of the matter can be given than that these young stages represent ancestral stages of the races to which the adults belong? But if this be admitted it is clear that the different "growth-gradients" which appear during the life-history of an organism are nothing but the coming to the surface of successive ancestral memories.

But the space allotted to this review will not permit us to discuss in detail the points in which we differ from Professor Huxley. One general criticism, however, we may permit ourselves: we regret very much that the author, in the attempt to make his book comprehensive, has included in it besides his own carefully documented researches the half-baked results of many other workers, many of them as yet unpublished and based on insufficient data. We think that his book would have gained in impressiveness by a reduction in size and a more thorough analysis of those cases where the data were abundant and reliable.

Books and Readers in Ancient Greece and Rome. By SIR FREDERIC G. KENYON. (Oxford University Press. 5*s*.).

The earliest technique of book-production and the earliest use made of books is a subject on which Sir Frederic Kenyon's qualities and experience throw interesting light. His own original work shows him to be a keen, precise, yet imaginative explorer into Greek and Roman literary origins as well as an erudite student of modern literature; and the sometime Director and Principal Librarian of the British Museum knows something about books in the mass.

In his present book Sir Frederic specially investigates the evolution from papyrus to vellum as the material of the earliest books produced and from the roll to the codex (the modern quire) as their form; he deals also with the effect of the form of books on literary history and criticism; and the origin and the growth of the practice of book-reading among the

ancient Greeks and Romans. The period he covers therefore stretches from the time of Homer—the date of whom he is shy of closely guessing—to the fourth century A.D., when vellum superseded papyrus. In his use of the evidence afforded by the latest archaeological discoveries, he shows himself to be human enough not to despise the unfortunate Grote as the easy foil. The immortality of the famous "History of Greece" has been given, as it were, a sort of inverted insurance policy by Sir Arthur Evans and his kind.

Sir Frederic argues attractively. His argument for a written Homer—whom he believes to have been a single person—is typical of his style. It is based, not upon the unlikelihood of such long poems as the *Iliad* and *Odyssey* being memorized by admirers, but upon the instruments of authorship itself. "The poems, once composed, could have been recited; but could they have been carried in the memory of the poet during the process of composition? And are we to picture the poet, after completing his *magnum opus*, as assembling a corps of rhapsodists around him, and reciting his work over and over to them until they had committed it to memory? It is difficult to believe. And if there was one original author's copy, why should not each rhapsodist, or at any rate each school of rhapsodists, have possessed one also? It seems easier to believe this than the contrary."

Granted the primitive existence of books, Sir Frederic deduces that they must have been rare, and their possession confined to the professional reciters; that they were made either of papyrus or of skin, not in a single volume, but in serial rolls. A feature and a difficulty of the subject is the lack of documentary evidence from classical Greek authors, which denies Sir Frederic the satisfaction of discovering the existence of libraries, in the sense of a common use of books, before the time of Aristotle. For the succeeding period of Greek literature the author's material is ample, and he makes an impressive showing for his claim that Alexandria as the centre of the literary life of the Hellenistic world reached a state of affairs "comparable with our own times." The period of widest practice in the reading of papyrus books he diagnoses as the second and third centuries A.D.

In addition to an equally interesting sketch of the development of the use of books and the practice of reading at Rome, Sir Frederic investigates in technical detail the methods of production and circulation of books, first in the form of the papyrus roll, then of the transitional "papyrus codex," and finally of the codex form in the vellum material.

The book is illustrated. It gives an intensely interesting hour's reading—it is not more than 30,000 words—and gains additional interest from the fact that the evidence that made it possible has all been discovered within the last half century.

Rome of the Renaissance and To-day. By SIR RENNELL RODD. Illustrated by HENRY RUSHBURY, A.R.A. (Macmillan. 25*s*.).

Sir Rennell Rodd's new book on Rome bears witness to his long acquaintance with the city and his close study of its monuments and traditions. No book on so stupendous a subject could pretend to be exhaustive, for Rome has twenty-five centuries of history. Yet it may safely be said that this detailed account of the city, quarter by quarter, with special reference to Renaissance work and to the many relics of antiquity that were used or remodelled at the Renaissance, contains very much that will be new even to those who have often visited Rome and have read their guide-books with care. Sir Rennell Rodd is a charming writer as well as a learned scholar, so that his book never wearies one. Mr. Rushbury's many careful drawings supplement the text admirably, but even without them it would give a vivid idea of the variety and complexity of historical Rome. After a brief chapter on the twenty-two regions or quarters (*rioni*) into which the city is divided, the authors begins with Campo Marzo and the house where Keats died, and thus starts in a leisurely perambulation which brings him at last to the Borgo, now Vatican City. Every piazza, church, column or fountain recalls some famous person or incident, for Rome is a city of memories that go far back into the past. Roman Emperors and mediaeval Popes, Anglo-Saxon kings, Byzantine, Norman and German potentates played their part in the evolution of the city, for good or for ill. The author reminds us, for instance, of the early development of the Anglo-Saxon colony in the Borgo under the shadow of the Castello Sant' Angelo. Caedwalla of Wessex in the early seventh century was the first of many English rulers to make the long pilgrimage and died in Rome a week after his baptism by Pope Sergius. His successor Ina, after a long reign, retired to Rome and built for his compatriots the church and school of S. Maria in Sassia—that is, in the Saxon quarter—which, centuries later, were transferred to the Hospitallers and, being rededicated, became the church and hospital of San Spirito in Sassia. Mediaeval Rome was a small and ill-kept town amidst a mass of ancient ruins. The Renaissance Popes and nobles began to bring order out of chaos and their successors have continued the work to the present day. To follow the process in detail and to indicate the salient features of the more notable monuments is the author's task, and it is most admirably performed. His knowledge and enthusiasm carry him and his reader without tiring through such a succession of interesting places as could not be equalled in the world. He links the past and the present all the more definitely because he remembers the Rome of half a century ago, before it began to be modernized and enlarged.

America Hispana. A Portrait and a Prospect. By WALDO FRANK. (Scribners. 16*s*.).

South America. A Continent of Contrasts. By KASIMIR EDSCHMID. (Thornton Butterworth. 18*s*.).

Argentine Tango. By PHILIP GUEDALLA. (Hodder & Stoughton. 8*s*. 6*d*.).

The first of these books was published some months ago, the other two are new. It would be hard to find three authors who have less in common than the American, the German and the Englishman who have given us their impressions of South America. Yet each of them has captured some distinctive aspect of the whole which goes to make up this "continent of contrasts." So much depends on the standpoint from which it is viewed. Mr. Frank and Herr Edschmid see the South American being slowly stifled by North American influences, but Mr. Guedalla dismisses such deductions as superficial, seeing in the Spanish character an individuality that will keep its proud possessors free from conquest of any kind. "Uncle Sam" may send his financiers to storm the continent, but in economic warfare it is always possible to reply by tariffs or repudiation, or both.

"America Hispana" is written by a radical who uses his subject to bring out all the worst tendencies in United States

foreign policy. During a lecture tour through Spanish America he was fêted everywhere, for nothing is easier in these countries than to raise a cheer at the expense of the "Yankee peril." Yet he also suggests that a new culture that is neither Spanish nor American will gradually emerge from the present troubles, which he regards as its birth pangs.

Mr. Edschmid's book has been chosen by the Book Society, and certainly no better account of modern South America has yet appeared. The author combines a fascinating description of his travels in all parts of the continent with a deep insight into the outlook of its peoples. The existing volumes of this kind are nearly all out of date, but Mr. Edschmid takes us down to the end of 1931 when General Uriburu had just become dictator in Argentina. He goes over the ground that was covered by Mr. Benn's articles in *Discovery* last year, and our only regret is that the photographs do not do justice to this otherwise admirable book.

In contrast with the thoroughness of the German author, Mr. Guedalla sketches his impressions in the briefest outline, yet giving a vivid picture of the Argentine point of view. It is a pity that he has not written a more detailed account of the travels which took him to Argentina with a party of Oxford and Cambridge undergraduates. He has, however, realized that Argentina is not South America, as many people fondly imagine, and this is admirably brought out in a paragraph about revolutions. "These spirited events," he says, "which serve so well to fill a column in a newspaper, have engaged the world's fancy; and it is a little apt to think of street fighting as the chief local pastime. By the simple expedient of never looking at a map it remains comfortably under the impression that traffic in the streets of Buenos Aires is gravely dislocated by a riot in Guatemala, which is not unlike a fond belief that an affray somewhere on the Persian Gulf disturbs the sleep of Edinburgh. . . . Few citizens of London would feel complimented if visitors from Buenos Aires took extravagant precautions before a walk down Oxford Street, because they had heard so much about disorder in the Balkans. Yet that is the blunder made by many Europeans about South America."

Episodes in a Varied Life. By Lord Conway of Allington. (Country Life. 15*s*.).

The title of Lord Conway's memoirs is an apt one. The author is known to us as explorer, mountaineer, professor of art, archaeologist, and Member of Parliament, and his recollections, taken refreshingly at random, are full of interest. The book follows no consecutive plan: Lord Conway, as he explains, has declined to record his career in the accepted manner, by "beginning with childhood and forbears, and trotting chronologically through the years down to old age." Thus the reader is transported from the British Museum to an island in the Aegean and back again to Dean Stanley and Westminster Abbey in the course of the first five pages. The narrative opens with Lord Conway in the King's Library of the British Museum, where he is engaged in studying an early print. On page 2, clad in pyjamas and an open shirt he is discussing the subject of German beer with the Archbishop of Syra in a church on the island, while a religious festival in honour of a local saint is in progress. The Archbishop sits upon a richly carved and gilded throne raised upon steps, while Lord Conway leans upon the arm of the throne in full view of the assembly. The Archbishop interrupts the conversation from time to time to take part in an elaborate ritual, being prompted the while by an official expert.

There is naturally much about mountaineering, and Lord Conway relates personal reminiscences of many noted climbers. His own adventures in the Himalaya and elsewhere are famous contributions to the annals of climbing. In a chapter entitled "Mountaineering Days," the author recalls the exploits of such men as Charles Edward Matthews, Horace Walker and Edward Whymper, who is associated with the Matterhorn disaster; the chapter concludes with the story of two remarkable coincidences in the Himalaya. There are recollections, too, of the Alpine Club and of the *Alpine Journal*, of which Lord Conway was at one time the editor. Travel in the Andes, Morocco, Tunis, Algiers, and in many other parts of the world are the subject of interesting chapters; and the book concludes with recollections of the Saville Club and its members. This is an engaging and witty book, full of interest and instruction. There are many illustrations.

Bird Haunts in Wild Britain. By R. N. Winnall and G. K. Yeates. (Allan. 10*s*. 6*d*.).

This book is distinguished by the naïve enthusiasm of the authors, and the excellence of their photographs. Of the latter the best are those depicting stone curlew, snipe and redshank, Arctic tern, Arctic skua and red-throated diver. The prints of the stone curlew, a wary bird which we have watched for many hours at close quarters, are extraordinarily clear and life-like; the one which shows the brooding patches is of great interest. Pictures of reed and sedge warblers reveal at a glance the difference between the nests of the two species. That of a heron in mid-air, just after leaving the nest, is not only a fine photograph, but an artistic masterpiece.

The authors admit that there is little new material in their book. Though its style is often needlessly discursive, it contains some careful observation. They confirm Mr. E. Selous's interpretation of the curious interest taken by rooks in the courtship and sexual activities of nesting pairs. They found that Arctic skuas which they watched at their nesting haunts, though belonging to both the light and dark varieties, did not necessarily pair accordingly to type, but inter-bred. One of these skuas was so curious about the lens of the camera that it walked up and inspected it at a distance of six inches. The authors made the interesting discovery that the lesser black-backed gull can count. When two men entered the hide and one walked away, the bird refused to return to the nest, but when three entered and two retired it came back at once. An Arctic tern whose eggs had been appropriated and brooded by another tern, together with her own youngster, attempted to brood the eggs of a ringed plover, and the authors photographed her in the act.

There was also the common gull who contentedly sat on one egg, neglecting the other which had rolled out of the nest, although it was so near that she could have touched it with her beak. These instances recall Professor Whitman's experiments with pigeons: a wild passenger pigeon deserted her eggs when removed only two inches from the nest; under similar circumstances domesticated pigeons usually attempted to retrieve both eggs, but were sometimes satisfied with one. With a wild bird brooding seems to be entirely a matter of instinct. So long as it is brooding something it is content.

The authors' attitude towards collecting is unsatisfactory. While they state that they do not collect, and condemn "the worst type of collector," they put in a plea for what they call the "moderate" (or, in another place, "honest") collector. We do not recognize the type. The collecting of British birds'

eggs has no longer any justification, either scientific or aesthetic; all have already been described *ad nauseam*, and are available to students in museums. Private hoards merely pander to individual selfishness. Aesthetically eggs lose their charm when removed from their natural surroundings. In order to protect the eggs of a stone curlew which they were photographing from a (presumably) "immoderate" or "dishonest" collector, the authors marked them with indelible ink. We know of a case in which the eggs of another and rarer species so marked were smashed by the collector, and an insulting note pinned to the tree trunk. Nor do we agree that the only way to decide whether the males of certain species of wader undertake the greater part or the whole of the duties of incubation is to shoot the bird from the nest. The point could be determined by careful watching.

Field Philosophy. By DOUGLAS GORDON. (Murray. 9*s*.).

Mr. Douglas Gordon says in his first chapter that "atmosphere" is the key-note of "Nature" books; we do not want "a mere recital of measurements and habits": we like "to hear the wind in the tree-tops, to catch the fresh scent of the earth and the wild blossoms." This book, he says, is "scarcely a Nature book." It deals with "the psychological side of animal nature from a purely logical standpoint" and particularly "the mental attitude of birds and beasts which oppose their wits to man." Certainly it has its own atmosphere: it smells of the good earth. Naturally most of the book is concerned with sport; there is much common sense in the chapters on "the Sporting Instinct," "Luck," and "Logic and the Game Laws"; those on pheasant, partridge and woodcock reveal a curious and intimate knowledge of their ways. The author's views on stag-hunting are refreshingly sane. He knows that its abolition would mean the destruction of the wild red deer, and that by means infinitely more cruel than the chase. His suggestion that the opponents of field sports would be better employed if they concentrated on the suppression of real cruelty, such as trapping with steel traps, is a sound one.

Scientifically, the most interesting chapters are those on "Instinct," "Intellect," and "the Senses of Animals." As the authors of "the Science of Life" remark, instinct is often used loosely for any unconscious impulse; they define it as "congenital behaviour"; this seems much the same as "inborn learning," which is Thompson Seton's definition adopted by Mr. Gordon. Most behaviour of birds and wild animals is instinctive, and therefore, as the author says, in their natural life there is little need of actual thought. In this respect they differ from man, who has "purchased intellect largely by the surrender of instinct"; hence the tendency of pseudo-nature writers to interpret an animal's actions according to human standards not only involves them in error, but often misses what is really interesting in a given piece of behaviour. Mr. Gordon thinks that it is only in its dealings with mankind that an animal requires intelligence; here instinct often fails it, and the grain of intelligence which might have saved it is usually absent. Some animals lack even the instinct of their race, *e.g.*, the beagle which took no interest whatsoever in hares!

Mr. Gordon believes that animals incur danger too frequently to know fear in the human sense. Rather, with them it takes the form of instinctive avoidance of imminent peril. And we think he is right when he doubts whether the animal mind can envisage death—as we know it. For us "the sense of death is most in apprehension." Wild animals live in the present. Animal senses, he says, are finer than ours; they depend on them for self-preservation. Probably they possess additional senses, such as an intuition of danger. But when Mr. Gordon suggests that scent is "a matter of sympathy, a form of magnetism" rather than a sense of smell, we cannot follow him. If so, why, as he admits elsewhere, do hounds leave their natural quarry for a drag? Nor can we agree with his sceptical attitude as to the woodcock's power of carrying her young. Mr. Seigne's observations, in "a Bird Watcher's Note-book," seem to us conclusive.

The book is full of meat, and should enhance the author's reputation. It contains some good stories. A rustic, commenting upon an idle and drunken neighbour whose financial position was eased by the charities bestowed in pity on his wife, remarked "The more you go wrong the more you'm thought of by the gentry."

There are some fine photographs by Miss Frances Pitt.

The Hilarious Universe. By RICHARD DARK. Illustrated by THOMAS DERRICK. (Blackwell. 4*s*. 6*d*.).

So This is Science! By H. F. ELLIS. Illustrated by ARTHUR WATTS. (Methuen. 5*s*.).

Messrs. Dark and Derrick have already displayed, in "Shakespeare and That Crush," a disposition to treat the Great with disrespectful levity. They have turned their attention from literature to science. After studying the modern girl from every angle, the authors have come to the conclusion that "she does not know her Universe." Certain vague notions appear to be floating in her mind—that the stars are a long way off and are made of coal gas, that the moon causes the Gulf Stream and the Channel Crossing, that the earth spins on its own axle once in 365 days and goes round the sun in twenty-four hours: but what does she know of the works of Galileo, Newton or Einstein? Finding the equipment of the modern girl sadly lacking in this respect, the authors have endeavoured to give some idea of the various theories advanced by the great thinkers, and to show what a dreadful muddle has been made of the whole thing. Finally, they have appended a short and simple scheme of the Universe, based on common sense and their own personal observations. Everyone with a sense of humour should read about this short and simple scheme.

Mr. Ellis, who claims to be egregious professor of all the sciences in the Universities of Oxford and Cambridge, abruptly plunges his readers into a discourse on the nature of the Universe which will surprise the physicists. The problem, he says, is this: either there is space or there is not; if there is not, there can be no such thing as distance, and we are all wasting our time travelling about in it. Thus a complex problem is made simple. As a shameless purveyor of inconsequential nonsense, Mr. Ellis is superb, and Mr. Watts' line in art is eminently suited to the subject.

Lovable Beasts. By HARPER CORY. (Nicholson & Watson. 12*s*. 6*d*.).

Mr. Cory is a member of that rapidly growing type of naturalist who prefer the camera to the rifle. He has given us here sixty-five excellent photographs of Canadian wild animals, not of game only, but also of the smaller though not less interesting creatures, such as the rodents and lesser carnivores. The photograph of a bull moose is exceptionally fine, and the view

of a cowboy patrolling a herd of bison is impressive. Incidentally we learn that the word " moose " is derived from *mu-su*, the Sioux name for the beast. Not the least interesting part of the book is the appendix, giving the history of the systematic preservation of wild life in North America and an account of the results achieved ; these are a matter for congratulation. It was Theodore Roosevelt who called the first National Conservation Congress at Washington in 1908, and in 1911 Canada created a special bureau to take charge of the same work in the Dominion. Americans have admitted that Canada is in advance of their own country in the active development of National Parks. The word " Park " is liable to create a false impression. These are by no means glorified Whipsnades, but vast open areas where the animals are subject to no restrictions whatever, may enter or leave at will, where there are " great numbers of animals that have never come into contact with man." " Area " or " reservation " would perhaps have been more suitable terms. Canada has no less than eighteen such parks, covering a total area of over 12,000 square miles. An exception is offered by the Buffalo National Park, which is surrounded by a high wire fence to retain bison and antelope ; but that is hardly noticeable, for the area thus enclosed is 197½ square miles ! The Provinces have their reserves too, such as the Algonquin Park, Ontario, where " it is easier to get away with murder than the killing of even a squirrel."

Thus not only the famous bison has been saved from extinction, but also the beaver, the bighorn sheep, the wapiti and the Rocky Mountain goat. The bison, once reduced to a few hundred head, has increased so greatly that in 1923 it was necessary to slaughter no less than 1,847 of them, and despite regular measures of reduction, the Canadian Government herd now numbers about 6,000. The largest collection of beavers, about 1,000, is in the Waterton Lakes National Park. In Jasper, which is about half the size of Wales, the population of creatures, many of which were not long ago menaced by extinction, is about 22,000 bighorn and as many deer, 10,000 caribou and as many moose, 4,000 bears and 3,500 wapiti.

The field observations and the splendid photographs give the book a definite scientific value, but the text is addressed to the young, for whom the book would be a splendid present.

This Electrical Age. By V. H. L. SEARLE. (Benn. 10*s.* 6*d.*).

Though electrical engineering is one of our most flourishing industries, it would be idle to deny that, to the general public who use it, electricity is still very much of a mystery, inspiring not a little fear. There could be no better introduction to the subject than Mr. Searle's new book. He showed himself to be a competent expositor of scientific problems in his " Everyday Marvels of Science," but he is even more helpful in this volume, which is specially concerned with electricity and its many practical applications. He begins with the general theory of the atom, the production of a vacuum, the spectrum and X-rays, and then deals in a most interesting way with various electrical contrivances. A chapter on electricity in the home includes the lamp and the fire, the bell, the iron and the vacuum cleaner—all simple matters, doubtless, but all well worth explaining. The measurement of time is discussed, with special reference to the electric chronograph : the measurement of low temperatures leads to a capital description of that most ingenious apparatus—the electric refrigerator ; and the measurement of high temperatures—a more technical subject—is considered in some detail. Finally there is an account of the methods of recording speech and music, especially for the gramophone. Mr. Searle has very wisely assumed that his readers will have some intelligence and patience ; they will be rewarded if they read his book with care.

The Vision of Asia. An Interpretation of Chinese Art and Culture. By L. CRANMER-BYNG. (Murray. 15*s.*).

Mr. Cranmer-Byng, as editor of " The Wisdom of the East " series, has stimulated popular interest in the literature and thought of China, Japan, India and Russia for many years past. He is a passionate but not indiscriminating admirer of Chinese culture at its best, in the Tang and Sung eras which ended when our Edward I began to reign in the later thirteenth century. In his new book he tries to indicate the main qualities of that remote civilization, so placid and well ordered in contrast to the chaotic turmoil of the China of to-day. The task is hard, and the author has made it harder by trying to comment on our restless modern ways as well as upon " The Way "—reposeful and dignified—of the Taoist doctrine, which, he thinks, was to a large extent followed in the idyllic capital of the Sung dynasty, that Hangchow which filled Marco Polo with admiration. The author is, however, so widely read and so happy in quoting the Chinese poets and philosophers that his main chapters are distinctly interesting and valuable. Sterner historians might question his conclusions, but in so far as he is dealing with the arts of China, based on immemorial traditions, he is an engaging and persuasive guide. The coloured frontispiece from an old Chinese print of flowers and birds is typical and beautiful.

From Piccadilly to Devil's Island. By ARTHUR MILLS. (Hutchinson. 12*s.* 6*d.*).

Captain Mill's volume of travel-sketches is, like a news film, attractive but unsatisfying. He has travelled widely and seen many unfamiliar places, like Cayenne, Cochin China and Ashanti, but he is content to give a rapid impression of each, with an anecdote or two, and then passes on. The French convict settlement at Cayenne shocked him as it has shocked others ; but what is to be done with the scoundrels who are sent there ? He says that one of the few in Devil's Island is Richard, who betrayed Nurse Cavell to the Germans. Human sacrifice, according to the author, is one of the old customs that still flourish in Ashanti. The most substantial chapter in the book is concerned with South America. There Captain Mills not only saw the sights of Rio and Buenos Aires, but also went up country in Brazil, towards the Matto Grosso diamond-fields and visited Paraguay. Not many Englishmen have steamed up the Parana beyond Asuncion to the frontier town of Corumba, near to which, in the the Chaco, Paraguay and Bolivia are again conducting a sort of war. The author made his way back overland through Brazil, untroubled by a local revolution. The book is attractively illustrated.

Whipsnade Zoo. By W. S. BERRIDGE. (Black. 3*s.* 6*d.*).

This book contains over forty delightful illustrations in photogravure of the animals at Whipsnade, with a short description of each. An account of the Zoo and its formation is given in an introduction. There are at present 2,500 animals " in residence " at Whipsnade. The author has made an apt choice and the photographs are very representative.

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